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EMERGENCY ARCHAEOLOGY: SALVAGE IN ADVANCE OF TECHNOLOGICAL PROGRESS

J. O. BREW

Director, Peabody Museum, Harvard University

(*Read April 22, 1960*)

FROM that time when the creature which we call man evolved into a sentient human being some part of his thoughts have ever been devoted to speculations about his origin. Even at that very early date it is assumed that there was some system to this. The myths and folklore of our few remaining primitive contemporaries provide patterns by which we can make conjectural reconstructions of the attempts of early man in this direction. All religions of which we have evidence are concerned about the past as well as with present well-being and future happiness. The carvings and paintings of the Upper Palaeolithic, although mainly preoccupied with the success of the hunt, bear witness to theories of background and beginnings. The advent of recorded history can be seen today on cave walls in France and Spain.

The invention of hieroglyphs and alphabet produced records which are much easier for us to read. On monuments of stone and tablets of clay, in Mesopotamia, along the Nile and in the jungles of Yucatan and Honduras, man recorded not only current affairs but also important events from past centuries in the history of his civilization.

Formal attention to material remains as part of man's search for knowledge of his past seems to have begun with excavation in Italy and Greece of objects to provide inspiration for the architects and sculptors of the Renaissance. Later, in northern Europe, excavation produced background for the Romantic Movement and the Nordic Revival in literature. In the New World, the first archaeological excavation was an American Indian site dug in Virginia by Thomas Jefferson, who published a report of his work, thereby setting an example not always followed by his successors.[1]

As the nineteenth century progressed, the discovery of Pompeii, Schliemann's excavations at Troy, the Egyptian Exploration Society, and the various topographic and railroad surveys in the western United States brought archaeology to the threshold of professional status. Professorships were established in universities, museums graduated from collectors' "cabinets" to scientific presentations of prehistoric cultures, and the academic community recognized a new discipline.

The history of archaeology is perhaps as fascinating as the subject itself and the purpose of this paper is to present a new dimension in archaeology; a departure which has had extraordinarily surprising results. Conceived in nothing short of panic, and nurtured by discouragement, it has matured in a manner which is well nigh unbelievable.

We did not plan it, at the outset we would have preferred not to have done it, and it was literally forced upon us; not only upon us as archaeologists, but upon us as governments, as businessmen, as engineers, and as private citizens. In fact, it may be said to have come about by accident. It is a textbook example of serendipity.

Because of it, an esoteric humanistic discipline which has never before had prominence except in realms of the imagination and as a very minor subject in academic halls, now finds itself of concern to the board rooms of great construction companies, to the world's most august legislative assemblies, to the cabinets of nations, and even to heads of state.

The most common name for it is salvage archaeology, and among other achievements which will presently be placed before you, it has done, is doing, or is about to do the following unexpected things:

It has built a museum in the middle of what was once the Zuider Zee.

It is turning the major river valleys of the world into vast archaeological laboratories.

It delayed the construction of new buildings in the centers of the bombed-out cities of Europe

[1] Jefferson, Thomas, Notes on Virginia, Paris, 1784 (dated 1782). Reprinted in *The Life and Selected Writings of Thomas Jefferson*, 221–224, The Modern Library, New York, Random House, 1944.

while archaeologists deciphered the remains of the earliest life in those cities.

It has joined together in a major scientific research program, effectively and for the first time, such diverse agencies of government as our Department of Defense, National Park Service, Federal Power Commission, Smithsonian Institution, and the Bureau of Public Roads.

It has caused a great natural gas pipeline company to devote space in its monthly house magazine to illustration and description of archaeological excavations which the company itself had made.

And, beginning this year, it will reopen the field of Egyptology which, for over a quarter of a century, has been virtually a closed book.

One may well ask how this has all come about. The basic answer to that question is the growth of populations and the technological developments which have been designed to meet that growth. Increase in the numbers of people, all over the world, has ever been a threat to the material manifestations of our historical and archaeological heritage. For millennia the centers of ancient civilizations have watched the great buildings of earlier generations fall before the tools of the wrecker to make way for the "modern" structure so sorely needed and so earnestly desired. Athens, Rome, Cairo, Damascus, London, and New York have all watched this process. Very occasionally a building has been so absolutely famous or has had so many influential friends that its survival has been permitted, an isolated monument to the past among the countinghouses, barracks, and blocks of flats of the moment. Rarely, the loss being realized, an important edifice has been reconstructed, often erroneously or in the wrong place; but for the most part the destruction has been continuous and progressive.

With the unprecedented developments of the twentieth century, both urban and rural, has come a realization that this thoughtless despoliation is a crime against civilization. Our cities are expanding at an alarming rate; more and more land is being brought under cultivation; major highways are cutting swaths hundreds of feet wide through the countryside; airfields are getting larger and larger; industry is building in places which previously knew only forest and pasture; and the river valleys of the world are being transformed into chains of large lakes which provide the water and the power to nourish our progress.

To meet this concerted threat to the remnants of our past the concept of salvage archaeology has developed. Obviously everything cannot be saved, but it can be surveyed and recorded. Outstanding sites can be excavated and important buildings can sometimes be moved. Archaeological salvage, carefully planned and executed, neither denies nor impedes progress. Occasionally the re-routing of a road or an alternate site for a dam will save the threatened monument without harm to the modern project. For the most part, however, the salvage consists of study and excavation, after which the construction can proceed. The salvage actually lies in the publication of the report of the archaeological research. Properly timed, the field work does not even retard the construction.

Formal and purposeful salvage archaeology began in 1907 when it was decided to increase the height of the Aswan dam, built at the first cataract of the Nile in 1902. The original dam inundated the important temples on the Island of Philae for part of each year. The proposed addition of seven meters to the dam would flood a considerable part of the valley in Nubia as far south as the village of Derr, a distance of 250 kilometers. Many archaeological sites were included in the area to be submerged and funds were set aside by the Egyptian government to provide for a systematic archaeological survey and necessary excavation. The work was directed by Professor G. A. Reisner of Harvard University, assisted by Messrs. C. M. Firth, A. M. Blackman, and Oric Bates. These men inaugurated salvage archaeology and the results of their work were published in seven detailed and exceptionally well illustrated quarto volumes by the Survey Department of the Ministry of Finance, Egypt.[2] The fact that salvage archaeology began in Egypt is of particular interest because one of the major projects during the next few years will be in connection with the new Aswan Dam, as described below.

The second major effort in this field was also in Egypt when, in 1929, it was decided to raise the height of the Aswan Dam a second time. The new inundation extended all the way to the border of the Sudan and the work was directed by Pro-

[2] Reisner, George A., *The archaeological survey of Nubia, report for 1907–1908*, 2 v. and plates and plans accompanying volume 1, plates accompanying volume 2, Cairo, National Printing Department, 1910. Firth, C. M., *The archaeological survey of Nubia, report for 1908–1909*, 2 v., and for 1909–1910, 1 v., Cairo, Government Press, 1912, 1915.

fessor Walter B. Emery, now of University College, London, assisted by Mr. L. P. Kirwan. Seasons of six months duration were devoted to survey and excavation during 1929, 1930, and 1931.[3]

Since 1920 much work has been done in Holland in the vast areas called *polders* which are being reclaimed for farming and settlement from the old Zuider Zee and behind large dams built in Russia and Siberia before and after the last World War. In the United States, one of the notable early examples of salvage archaeology was the discovery of the Boylston Street fishweir during the construction of a street car subway in Boston in 1913. This study was extended by finds made, also on Boylston Street, during the excavations for the foundations of cellars of the Prudential Life Insurance building in 1929.[4]

The first major program in salvage archaeology in the United States was in connection with the construction work of the Tennessee Valley Authority and was carried out in the 1930's under the direction of Major William S. Webb, then chairman of the Department of Anthropology of the University of Kentucky. Large numbers of sites were surveyed and excavated before the waters rose in the reservoirs of the Tennessee River drainage.[5] The most extensive salvage program to date, however, is the Inter-Agency Archaeological Salvage Program of the United States Government established after the Second World War.

In 1945 a group of archaeologists realized, suddenly, the tremendous amount of destruction that was threatened in the River Basin projects of the United States Bureau of Reclamation and the Corps of Engineers. At that time 108 dams had been authorized in the Missouri basin alone. Since almost all of the prehistoric and early historic occupation of the Missouri had been on the banks of the main stream and its tributaries, a large part of our heritage there was scheduled to go under water. In North and South Dakota, the Oahe Lake alone is to be 308 miles long and lakes almost as large are now filling up immediately upstream and downstream from it. And the threat lay not only in the Missouri, but in river basins all over the country, from Oregon to New England and from Minnesota to Texas.

To meet this threat an independent group, the Committee for the Recovery of Archaeological Remains, was organized to represent the archaeologists of the nation. It was sponsored by the American Council of Learned Societies, the Society for American Archaeology, and the American Anthropological Association. The task seemed overwhelming, and to archaeologists a frontal attack upon the forces of bureaucracy was almost appalling. But a few were found who, inexperienced as they were in the Washington maelstrom, nonetheless, recognizing the dire necessity, assumed the chore.

Enthusiastic assistance was obtained at the outset from the archaeologists in the Smithsonian Institution who prepared specific estimates of ways, means, and costs. On the administrative side, the officers of the National Park Service, under the authority of the Antiquities Act of 1906 and the Historic Sites Act of 1935, provided valuable guidance. After a number of conferences, a series of interagency agreements was drawn up between the scientific agencies, the National Park Service and the Smithsonian, on the one hand; and on the other, the two construction agencies involved, the Bureau of Reclamation and the Corps of Engineers. After more conferences, testifying before committees, and a period of alternating hope and dismay, the Congress made an appropriation which enabled the program to get started.[6]

The major scientific responsibility was placed upon the broad shoulders of Dr. Frank H. H. Roberts of the Bureau of American Ethnology in the Smithsonian, where it has rested ever since. Partly because of its convenient regional organization throughout the country, which coincides roughly with the regional organization of the construction agencies, the administrative and

[3] Emery, Walter B., The royal tombs of Ballana and Qustul, Cairo, *Service des Antiquités de l'Egypte*, 1938, and Emery, Walter B., *Nubian Treasure*, London, Methuen, 1948.

[4] Johnson, Frederick, The Boylston Street fishweir, *Papers of the Robert S. Peabody Foundation for Archaeology* **2**: 1–212; **4**: 3–133, Phillips Academy, Andover, Mass., 1942, 1949.

[5] As examples of the many detailed monographs arising from the Tennessee Valley work see: Webb, William Snyder, An archaeological survey of the Norris Basin in eastern Tennessee, *Bull. Bur. Amer. Ethnol.* **118**, Washington, Government Printing Office, 1938, and Webb, William Snyder and David L. DeJarnette, An archaeological survey of Pickwick Basin in the adjacent portions of the states of Alabama, Mississippi and Tennessee, *Bull. Bur. Amer. Ethnol.* **129**, Washington, Government Printing Office, 1942.

[6] The beginnings of the federal program are outlined in: Brew, J. O., and others, Symposium on river valley archaeology, *American Antiquity* **12**: 209–225, 1947.

budgetary side was assumed by the Park Service. Dr. Ronald F. Lee, now Regional Director of the Park Service in Philadelphia, was then in the Washington Office as Chief Historian and his capable hands have shaped and guided that side of the program until his transfer to Philadelphia a few months ago. Recently, in order better to administer not only the work in the river valleys but also the ever increasing amount of archaeological research and interpretation necessary in the 184 areas in the country under their control, the Park Service has established a Division of Archaeology. Its head, Dr. John M. Corbett, is now the chief administrator of that part of the program.

From very small beginnings in 1946, surveys and excavations have been carried out in reservoir pool areas in all of the major and many of the minor river basins of the country. In a pamphlet issued by the Committee for the Recovery of Archaeological Remains, with the assistance of the American Council of Learned Societies,[7] the following rough totals are given for the work accomplished by federal agencies under the program during the years 1946 through 1957. Archaeological, historical, and palaeontological surveys had been made in 310 reservoirs in 42 states. More than 9,000 sites had been located and recorded. These include prehistoric villages, burial grounds, trails, quarries, fur-trading posts, military forts, pioneer cabins and early frontier settlements. Excavations had been conducted in 69 reservoir areas in 31 states. Over 4,000,000 specimens had been found. During the last three years this total has been increased by at least ten per cent.

But this is not all. At the very outset the magnitude of the task made it obvious that the federal government could not do it alone. Consequently the cooperation of state and private organizations was solicited. The response was extremely gratifying. Over sixty universities, archaeological and historical societies, and museums have made surveys and excavations.[8] When the results of their work are all available, the figures given above will be doubled.

When the original plans were being made in 1945, there were qualms in many quarters about the expense of the enterprise. It is still true that sufficient funds are not being made available to permit the work to be done as completely as it should be. Yet the price we have to pay for this really large amount of survey and excavation is remarkably small. It is estimated that the average cost to the federal government is less than one-half of one per cent of the construction cost of the dams and that the total amount involved is in the order of approximately one-fifth of a cent per year per capita.

For this we are gaining knowledge of our prehistoric and early historic past far beyond the dreams of a preceding generation of archaeologists. At first many deplored the demands of the program, fearing that there would be a loss through pulling men away from researches they had planned in order to cope with the emergency. This has not proved to be the case. There is more excavation going on outside the river basins than ever before, while within the basins we are deciphering the main lines of cultural development and the movement of prehistoric populations. Archaeologists themselves, for the most part, still do not realize the extent of the record that is being compiled by the river basin studies. The pre-Columbian inhabitants of the New World did not possess the wheel and, with the limitation this fact exerted on land transport, it is estimated that eighty per cent of the inland population lived along the rivers. In the Missouri basin the pro-

FIG. 1. An archaeological site under excavation by the Smithsonian Institution in the pool area of Angostura Reservoir, Fall River County, South Dakota. The upstream face of the Angostura Dam is to be seen under construction in the background. (Credit photo: Missouri Basin Project, Smithsonian Institution.)

[7] *The inter-agency archaeological salvage program after twelve years*, Columbia, Mo., University of Missouri, 1958.

[8] See list at end of paper, pp. 9–10.

FIG. 2. Air view of the Buffalo Pasture Village Site, in center foreground, before it was submerged by the rising waters of Oahe Reservoir, South Dakota. (Credit photo: Missouri Basin Project, Smithsonian Institution.)

portion was much higher and all of the known sites of five prehistoric cultures in Nebraska and the Dakotas are going under water behind the dams. In comparison with the rate of normal archaeological research the compulsion exerted by this emergency has advanced our knowledge by decades if not by centuries.

Salvage archaeology, however, is not restricted to the river valleys. Shortly after the establishment of the River Basin Program a new threat to our prehistoric past arose. Industrial usage of oil and natural gas had reached the point where tank car transport could not keep up with the demand and our engineers perfected methods of moving these commodities through pipelines. Huge trenching machines began cutting ditches through hundreds of miles of countryside. Particularly in the southwestern states, this again meant the destruction of sites. So pipeline salvage came into being and archaeologists are now standard personnel on major pipeline projects. They are employees of the companies in many cases, and the costs of the work, and of the preparation and publication of reports, are included in the project estimates.[9]

An even more serious threat than the pipelines became apparent with the announcement of President Eisenhower's fifty-six billion dollar road program. By this time the archaeological profession had become alert, and the Society for American Archaeology immediately set up a Highway Salvage Committee under the leadership of Dr. Fred Wendorf, director of anthropological research at the Museum of New Mexico.

FIG. 4. The Hitchell Village Site in the Fort Randall Reservoir Area, South Dakota. The village which was occupied by two Indian tribes has now been completely covered by the rising waters. It lies between the man standing on the shore and the two tree-top branches projecting above the surface well out in the lake. (Credit photo: Missouri Basin Project, Smithsonian Institution.)

The road salvage program has been in being for little over three years, yet in New Mexico alone 250 new highway routes have been surveyed by archaeologists and seventy-two sites dug in the rights-of-way or in the areas of the material pits from which road metal is obtained.[10] Highway

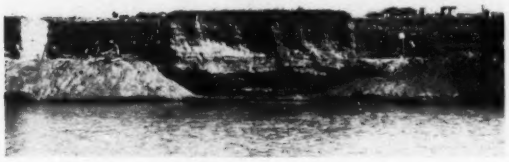

FIG. 3. Archaeologists excavating an ancient camp site at the edge of the rising waters of Tiber Reservoir on the Marias River in Montana. (Credit photo: Missouri Basin Project, Smithsonian Institution.)

[9] Wendorf, Fred, ed., *Pipeline archaeology; reports of salvage operations in the Southwest on El Paso Natural Gas Company project, 1950–53*, Santa Fe and Flagstaff, Laboratory of Anthropology and Museum of Northern Arizona, 1956.

[10] Wendorf, Fred, ed., *Highway salvage archaeology*, 3 v., Santa Fe, New Mexico State Highway Department and Museum of New Mexico, 1954, 1956, 1957.

salvage is now organized in nine other states—Arizona, California, Florida, Illinois, Wisconsin, Oklahoma, Nebraska, Utah, and Oregon. All states must follow suit or great losses will ensue. The Federal Bureau of Public Roads has been most helpful but in this program the cooperation of the respective state highway departments is also necessary as they actually build the roads.

In both the river basins and along the highways, the archaeologists have received magnificent cooperation from the construction agencies. In Washington, in regional offices, and in the field, men of the Corps of Engineers, the Bureau of Reclamation, the Bureau of Public Roads, and the Federal Power Commission, have rendered extraordinary assistance to the archaeologists, and we are most grateful.

FIG. 5. Looking out through the opening of a Basket-maker Cave in Desha Canyon, a southern tributary to the San Juan River in Utah, in the area to be flooded by the Glen Canyon Reservoir. The canyon floor shown in the picture was cultivated by these early Southwestern farmers in the early centuries of the first millennium B.C. (Photo credit: Museum of Northern Arizona/Christy G. Turner II.)

When all this is put together, along with individual local salvage projects in connection with new airfields, factories, motel developments, land clearance for farming and the like, the significance of the development becomes clear. In 1945 we had considerable knowledge of our prehistory in only a very few areas, or more properly, in only a very few places. Between these places were gaps, many of them of great size, about which we knew nothing. The salvage work in the river basins and along the roads and pipelines is filling in these gaps with surprising rapidity. The results of this work are presented in a large number of papers in scientific journals and in an ever growing series of monograph reports.[11] A list

FIG. 6. Gates Roost, where primitive farmers sheltered under the overhanging cliffs. A man can be seen standing in one of the slab walled houses which were located on a ledge eighty feet above the floor of the valley. The stream at the left is Twenty-five Mile Wash, a tributary of the Escalante River in the Upper Colorado Glen Canyon project in Utah. (Credit photo: Department of Anthropology, University of Utah.)

FIG. 7. Salvage archaeology on the Glen Canyon project in Utah packs other thrills than finding a Basket-maker mummy. A Museum of Northern Arizona crew in Thirteen Foot Rapid on the San Juan River. (Credit photo: Museum of Northern Arizona/Christy G. Turner II.)

[11] For example: Lehmer, Donald J., Archaeological investigations in the Oahe Dam area, South Dakota, 1950-1951, Inter-Agency Archaeological Salvage Program, River Basin Surveys Papers No. 7, *Bull. Bur. Amer.*

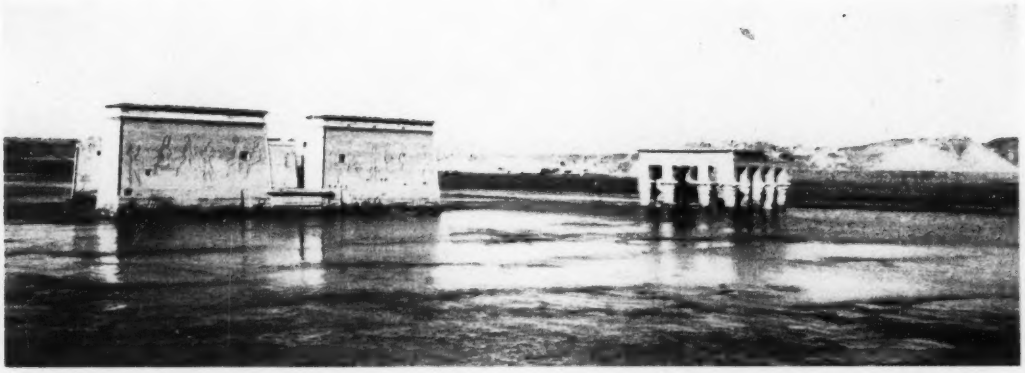

FIG. 8. The Temple of Isis and Trajan's Pavilion on the Island of Philae, near Aswan, above the First Cataract of the Nile. Salvage plans call for the re-creation of the Island in its original form through the construction of three low earthen dams. (Credit photo: UNESCO/M. Laurenza.)

of papers and reports is published periodically by the Smithsonian Institution.[12]

This presentation does not wish to give the impression that the achievements of the various salvage programs in the United States during the past fifteen years have been perfect. There have been irreparable losses in the river basins and there will be more if the Congress does not increase the appropriations for the coming year. Constant vigilance by archaeologists and the public will be necessary to protect our sites from destruction in road and building construction.

The results of the various programs, however, in the increase to our knowledge of the prehistoric and historic past have been noteworthy and exciting. Systematic information is rapidly becoming available of areas of our country and of early cultures about which, previously, we knew little or nothing. And to the world of scholarship in general perhaps the most significant fact is that salvage archaeology has become far more than a mere emergency rescue operation for saving individual sites and buildings. Geologists, palaeontologists, botanists, and zoologists are joining with the archaeologists and historians. The ecological studies program in the most recent of our river basin projects, the Upper Colorado, is a good example of this.[13] Climatic changes and the effects of drought, erosion, flooding and silting upon populations through time have become part of the research. The Missouri Basin Chronology Program of the Smithsonian Institution demonstrates the assistance being received from the physical sciences with their rapidly developing new dating techniques, of which Carbon-14 analysis is the most striking. In all parts of the country many fields of knowledge are bringing their resources to bear to make these programs truly interdisciplinary, to discover and describe as much as possible about past human occupancy, and to insure that the historic record does not disappear forever as a victim of our progress.

One more aspect, the newest one, of salvage archaeology remains to be discussed. On March 8, 1960, the Director-General of UNESCO issued an international appeal in a world-wide campaign for the study, excavation, and preservation of the thousands of archaeological sites on the Nile in the Egyptian province of the United Arab Republic and in the Republic of the Sudan which are threatened by the construction of the new high dam at Aswan.

Under UNESCO auspices two international committees have been established: a Committee of

Ethnol. **158**, Washington, Government Printing Office, 1954, and Lipe, William D., 1958 Excavations, Glen Canyon Area, Glen Canyon Series No. 11, *Anthropological Papers*, Salt Lake City, University of Utah Press, 1960.

[12] For example: Appendix 5, List of reports, articles, and notes relating to the salvage program published in other series, 235–243, in Osborne, Douglas, Excavations in the McNary Reservoir Basin near Umatilla, Oregon, Inter-Agency Archaeological Salvage Program, River Basin Survey Papers No. 8, *Bull. Bur. Amer. Ethnol.* **166**, Washington, Government Printing Office, 1957. More than 300 reports and articles have been published to date.

[13] For example: Woodbury, Angus M., Stephen D. Durrant and Seville Flowers, A study of vegetation in the Flaming Gorge Reservoir basin, Upper Colorado Series No. 2, *Anthropological Papers*, Salt Lake City, University of Utah Press, 1960.

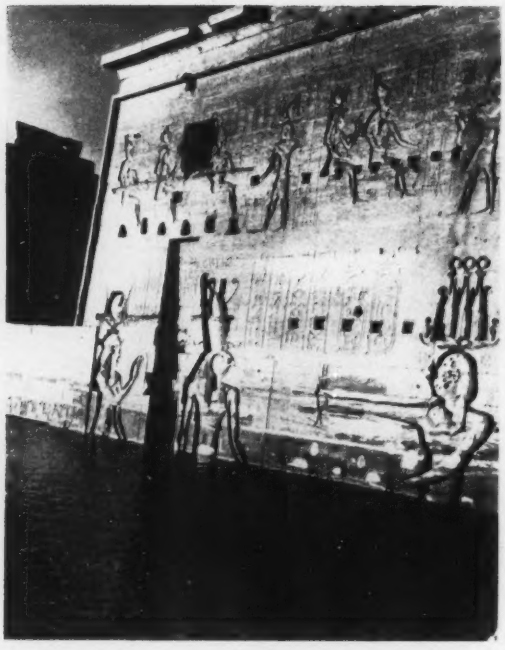

FIG. 9. Detail of the temple of Isis at the Island of Philae near Aswan in Egypt. The salvage plan for Philae will preserve this outstanding building permanently on dry land. (Credit photo: UNESCO/M. Laurenza.)

Patrons under the chairmanship of His Majesty King Gustaf VI Adolf of Sweden, himself a practicing archaeologist, and an action committee to organize the campaign. Committees of experts have also been set up to advise the two governments concerned. National committees are being organized in countries interested in participating. The executive secretary for the United States Committee is Professor John A. Wilson of the Oriental Institute, University of Chicago.

As an inducement to scholars and museums, the United Arab Republic has abandoned its policy of prohibiting the export of archaeological material. At least fifty per cent of the objects excavated in Nubia can be removed from the country except for specimens needed to complete the national collections. In addition, some of the temples which are going under water are available for export and institutions making appreciable contributions to the salvage in Nubia will be permitted to excavate elsewhere on the same basis or to receive specimens from the extensive archaeological stores.[14] The implementation of this policy will revive excavation in Egypt which in recent years, because of the export restrictions, has been almost abandoned by foreign institutions.

The problem is stupendous, far beyond the ability of Egypt and the Sudan to tackle alone. High water level behind the present dam is 121 meters. The high dam will raise it to 182 meters. The resulting lake will flood permanently the inhabited areas of both modern and ancient Nubia. Thousands of archaeological sites will be inundated extending in time from the Palaeolithic to Coptic Periods. As noted earlier in this paper, thorough surveys have been made up to present high water level. Above the 121 meter level little is known and a complete survey must be made. Many sites will have to be excavated and smaller temples must be moved. The two major sites in Egyptian Nubia, the Island of Philae and the great rock-cut temples of Abu Simbel will have to be protected *in situ* by earth dams.[15]

FIG. 10. The Graeco-Roman temple of Kalabsha, south of Aswan, built in the time of Augustus on the remnants of a building of the fifteenth century B.C. This is considered to be the third most important structure in the region to be flooded and it is proposed to move it to a suitable location elsewhere in Egypt. (Credit photo: UNESCO/M. Mariani.)

[14] The outline of the campaign, Declaration by the Government of the United Arab Republic, etc., is to be found in a well-illustrated booklet of 32 pages, *A common trust: the preservation of the Ancient Monuments of Nubia*, Paris, UNESCO, 1960.

[15] The February 1960 issue of *The UNESCO Courier* is devoted to the Nubian problem. It includes twelve well-illustrated articles and an eight-page color section. It can be obtained in the United States for 60 cents from UNESCO Publications Center, 801 Third Avenue, New York 22, New York.

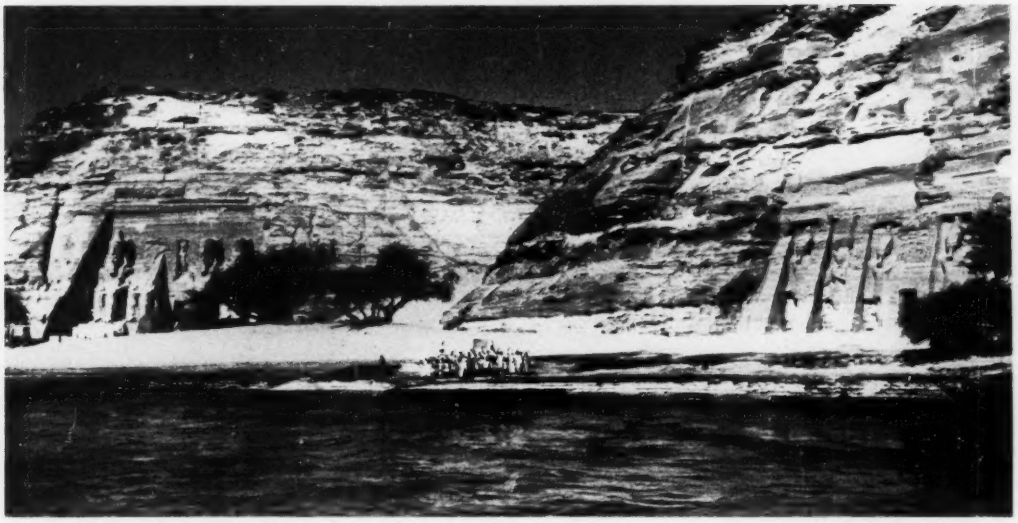

FIG. 11. The entrances to the two rock-cut temples at Abu Simbel in Egypt close to the Sudan frontier. The four seated statues of Ramses II at the portal of the Great Temple on the left are 67 feet in height. Inside are large and small chambers carved out of the rock containing many other sculptures and walls covered with carvings and inscriptions. When the high dam is built the temples will be permanently submerged. At high water the rock out of which the Great Temple is carved will project only a short distance above the surface of the lake. It is hoped to preserve these temples by means of an earthen dam well away from the portals so that it will still be possible to obtain a view similar to the one in this picture. (Credit photo: UNESCO/M. Laurenza.)

Work has already begun. In the Sudan, Professor Walter B. Emery is excavating the remarkable Middle and New Kingdom fortress of Buhen, which he recently discovered; and Dr. William Y. Adams from our Upper Colorado salvage project has completed the excavation of a pottery factory just south of the Egyptian border. In Egypt, work has already begun on the moving of temples, and the Documentation Centre on Ancient Egypt, with the cooperation of UNESCO, is completing its photogrammatric survey of the Nubian monuments.

The situation in Nubia presents the greatest challenge yet to be faced by salvage archaeology. Two of the sites to be flooded are considered to be of first importance in the history of the development of civilization as we know it. The Nile itself has been a major route of migration and trade for hundreds of thousands of years. More and more physical anthropologists are coming to believe that some of the strains of mankind originated in Africa. If this is so, the Nile may well be the route by which man first reached the Mediterranean, the Near East, and Western Europe. However this may be, the archaeology of the Nile is important to all the world. The fist-axes on the terraces, the temple of Isis at Philae, and Mirgissa Fortress opposite Wadi Halfa are as important to Oxford, Zurich, Tucson, and Warsaw as they are to Cairo and Khartoum. The international appeal for salvage in Nubia emphasizes that prehistory transcends nationalism and that archaeology belongs to us all.

THE INTER-AGENCY ARCHAEOLOGICAL SALVAGE PROGRAM

COORDINATING AGENCIES

National Park Service, U. S. Department of the Interior
The Smithsonian Institution

COOPERATING FEDERAL AGENCIES

Bureau of Reclamation, Department of the Interior
Corps of Engineers, United States Army
Federal Power Commission
International Boundary and Water Commission
United States Geological Survey, U. S. Department of the Interior

COOPERATING STATE AGENCIES INSIDE THE MISSOURI BASIN

Nebraska State Historical Society
North Dakota State Historical Society
South Dakota Historical Commission
University of Denver
University of Idaho
University of Kansas
University of Missouri
University of Montana
University of Nebraska
University of North Dakota
University of South Dakota
University of Utah
University of Wisconsin
University of Wyoming

COOPERATING STATE AND OTHER AGENCIES OUTSIDE THE MISSOURI BASIN

Amerind Foundation, Arizona
Archaeological Society of North Carolina
Beloit College, Wisconsin
Carnegie Museum of Pittsburgh
Dallas Archaeological Society
Florida Historical Society
Florida State Parks Board
Idaho Power Company
Idaho State College
Indiana State Historical Society
Missouri Archaeological Society
Museum of Northern Arizona
New Mexico State Museum
New York State Museum
Ohio State Historical Society
Public Utility District #1, Chelan County, Washington
Public Utility District #2, Grants County, Washington
Roswell Museum of New Mexico
Sacramento State College, California
State College of Washington
Temple University, Pennsylvania
University of Alaska
University of Arizona
University of Arkansas
University of California at Berkeley
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University of Georgia
University of Kentucky
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University of Missouri
University of New Mexico
University of Oklahoma
University of Oregon
University of Southern California
University of Texas
University of Utah
University of Washington
Western State College, Colorado

THE FULL-MOON AND NEW-MOON SACRIFICES IN THE TAITTIRĪYA-BRĀHMAṆA

(FOURTH PART)

The Anuvākas 1–6 and 11 of The Seventh Prapāṭhaka of the Third Kāṇḍa of the Taittirīya-Brāhmaṇa with Translation

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3.7.6 Stanzas and sacrificial formulas that should be recited at the full-moon and new-moon sacrifices. All these stanzas and formulas should be recited by the Sacrificer or by the Adhvaryu, except the formula (*c*), which should be recited by the Brahmán, and the two formulas (*y* and *cc*), which should be recited by the Āgnīdhra 28

3.7.11 The twenty-eight stanzas and formulas which the Adhvaryu should recite when, at the end of the sacrifice, he offers the *sarvaprāyaścittāni*, i.e., the libations of atonement for everything 34

PREFATORY NOTE

THE Taittirīya-Brāhmaṇa deals with the full-moon and new-moon sacrifices in four Prapāṭhakas of the Third Kāṇḍa, namely 3.2, 3.3, 3.5, and 3.7. The Prapāṭhakas 3.2 and 3.3 contain, presented in chronological order, theological and ritual explanations referring to the principal rites of these sacrifices; and the Prapāṭhaka 3.5 contains, presented in chronological order, the stanzas and formulas that should be recited by the Hotar in the course of these sacrifices. I have already published the translation of these three Prapāṭhakas in Vol. 101, 103, and 104 of the *Proceedings* of the American Philosophical Society, and now I am publishing the translation of the seven *anuvākas* of the seventh Prapāṭhaka that deal with the full-moon and new-moon sacrifices. The first three *anuvākas* of this Prapāṭhaka contain theological and ritual explanations referring to the atonement-rites for mistakes and mishaps that may occur at these sacrifices. The three following ones constitute a collection of *mantras* (stanzas and formulas) that should be recited at the full-moon and new-moon sacrifices. This collection is interesting because most of these *mantras* are to be found only in the Tait.-Br. and in the Śrautasūtra of Āpastamba. But this collection is presented in a strange way. There is no chronological order, and apparently no rational order. Most of the stanzas and formulas of this collection should be recited by the Sacrificer or the Adhvaryu, but some of them are to be recited by the Āgnīdhra or other priests, and some by the wife of the Sacrificer. The last of the *anuvākas* that deal with the full-moon and new-moon sacrifices is 3.7.11. It contains the twenty-eight *mantras* which the Adhvaryu should recite when, at the end of the sacrifice, he offers the *sarvaprāyaścittāni*, i.e., the libations of atonement for everything. My translation is as literal as possible. Some passages of the text are difficult. For my

interpretation of these passages, Caland's excellent translation of the Śrautasūtra of Āpastamba has been very helpful, although in a few cases I do not agree with him. I have also used with profit the first volume of the Śrautakośa published by the Vaidika Saṃśodhana Maṇḍala (Poona, 1958).

Just as in the case of my other translations of the Taittirīya-Brāhmaṇa, my translation of these seven *anuvākas* of the seventh Prapāṭhaka is accompanied by an accented transliteration of the text. It is the text of the Ānandāśrama Series, and the numbers enclosed in brackets in the transliterated text [1], [2], [3], etc., correspond to the numbers which are inserted in the text of the Indian edition; they indicate the subdivisions of each *anuvāka*. But, as these subdivisions are quite arbitrary, I added the letters (*a*), (*b*), (*c*), etc., in order to indicate more rational subdivisions. Only in a few cases have I corrected an evident misprint or ventured a conjecture.

The reader will find a summary of the rites of the full-moon and new-moon sacrifices, according to Āpastamba, in the introduction to my translation of Tait.-Br. 3,2 (*Proc. Amer. Philos. Soc.* **101**: 217).

ABBREVIATIONS

Āp.	= Āpastamba-Śrautasūtra.
Āśv.	= Āśvalāyana-Śrautasūtra.
AV.	= Atharvaveda-Saṃhitā.
Baudh.	= Baudhāyana-Śrautasūtra.
RV.	= Ṛgveda-Saṃhitā.
Tait.-Br.	= Taittirīya-Brāhmaṇa.
TS.	= Taittirīya-Saṃhitā.
Śat.-Br.	= Śatapatha-Brāhmaṇa.
Śāṅkh.-Śr.	= Śāṅkhāyana-Śrautasūtra.
Caland	= Das Śrautasūtra des Āpastamba aus dem Sanskrit übersetzt.
JAOS	= Journal of the American Oriental Society.

3.7.1

(*a*) sárvān vā eṣò 'gnáu kāmān práveśayati, yò 'gnín anvādhāya vratám upáiti; sá yád ániṣṭvā prayāyāt, ákāmaprītā enaṃ kāmā nā 'nu prāyāyuḥ; atejā avīryàḥ syāt; sá juhuyāt, túbhyaṃ tā aṅgirastama, víśvāḥ sukṣitáyaḥ pṛthak, ágne kāmāya yemira íti; kāmān evā 'smin dadhāti [1], kāmaprītā enaṃ kāmā ánu prāyānti, tejasvī vīryàvān bhavati.

(*b*) sāṃtatir vā eṣā yajñásya, yò 'gnín anvādhāya vratám upáiti; sá yád udvāyati, vicchittir evā 'sya sā; tāṃ prāñcam udbhṛtya, mánasó 'patiṣṭheta; máno vái prajāpatiḥ, prājāpatyó yajñáḥ [2], mánasai 'vá yajñáṃ sāṃtanoti; bhūr íty āha; bhūtó vái prajāpatiḥ; bhūtim evó 'paiti.

(*c*) ví vā eṣā indriyéṇa vīryèṇa rdhyate, yásyā "hitāgner agnír apakṣāyati; yāvac chāmyayā pravídhyet, yádi tāvad apakṣāyet, táṃ sāṃbharet, idáṃ ta ékaṃ parā uta ékam [3], tṛtīyena jyótiṣā sāṃviśasva, saṃvéśanas tanúvai cārur edhi, priyé devānāṃ paramé janítra íti; brāhmaṇai 'vái 'naṃ sāṃbharati; sái 'vá tātaḥ prāyaścittiḥ.

(*d*) yádi parastarām apakṣāyet, anuprayāyā 'vasyet; só evá tātaḥ prāyaścittiḥ.

(*e*) óṣadhīr vā etásya paśūn pāyaḥ práviśati, yásya haviṣe vatsā apākṛtā dhāyanti [4]; tān yád duhyāt, yātāyāmnā haviṣā yajeta; yán ná duhyāt, yajñaparúr antāriyāt; vāyavyāṃ yavāgūṃ nírvapet; vāyúr vái pāyasaḥ pradāpayitā; sá evā 'smai pāyaḥ prádāpayati; pāyo vā óṣadhayaḥ, pāyaḥ pāyaḥ; pāyasai 'vā 'smai pāyó 'varundhe [5]; āthó 'ttarasmai haviṣe vatsān apākuryāt; sái 'vá tātaḥ prāyaścittiḥ.

(*f*) anyatarān vā eṣā devān bhāgadhéyena vyàrdhayati, yé yājamānasya sāyāṃ gṛhām āgácchanti, yásya sāyaṃ-dugdhāṃ havír ārtim ārcháti; índrāya vrīhīn nirúpyó 'pavaset; pāyo vā óṣadhayaḥ; pāya evā "rābhya gṛhītvó 'pavasati; yát prātāḥ syāt, tác chṛtāṃ kuryāt [6]; āthé 'tara aindrāḥ purodāśaḥ syāt; indriyé evā 'smai samīcī dadhāti; pāyo vā óṣadhayaḥ, pāyaḥ pāyaḥ; pāyasai 'vā 'smai pāyó 'varundhe; āthó 'ttarasmai haviṣe vatsān apākuryāt; sái 'vá tātaḥ prāyaścittiḥ.

(*g*) ubhāyān vā eṣā devān bhāgadhéyena vyàrdhayati, yé yājamānasya sāyāṃ ca prātāś ca gṛhām āgácchanti, yásyo 'bhāyaṃ havír ārtim ārcháti [7]; aindrāṃ pāñcaśarāvam odanāṃ nírvapet; agníṃ devátānāṃ prathamāṃ yajet; agnímukhā evā devátāḥ prīṇāti; agníṃ vā ánv anyā devátāḥ, índram ánv anyāḥ; tā evó 'bhāyīḥ prīṇāti; pāyo vā óṣadhayaḥ, pāyaḥ pāyaḥ; pāyasai 'vā 'smai pāyó 'varundhe; āthó 'ttarasmai haviṣe vatsān apākuryāt [8]; sái 'vá tātaḥ prāyaścittiḥ.

(*h*) ardhó vā etásya yajñásya mīyate, yásya vrātyé 'han pātny anālambhukā bhávati; tām aparúdhya yajeta; sárveṇai 'vá yajñéna yajate; tām iṣṭvó 'pahvayeta, ámū hám asmi, sā tvám, dyáur ahám, pṛthivī tvám, sāmā 'hám, ṛk tvám, tāv éhi sāṃbhavāva, sahā réto dadhāvahai, puṃsé putrāya véttavai, rāyás póṣāya supra-

jāstvāya suvíryāyé 'ti; ardhá evái 'nām úpahvayate; sái 'vá tátaḥ práyaścittiḥ [9].

[This chapter and the two following ones contain ritual and theological explanations referring to the atonement-rites for mistakes and mishaps that may occur at the full-moon and new-moon sacrifices.]

(*a*) Verily he causes all his desires to enter into Agni (the Fire), he who, after having added fuel to the sacred fires, enters on the religious vow. (Consequently,) if he should go out on a journey (after having added fuel to the sacred fires, but) without having offered the sacrifice, his desires, not being fulfilled with their objects of desire, would not accompany him on his journey; he would be without fiery energy, without manly power. (Therefore, through the mediation of the Adhvaryu,) he should offer an oblation with the formula: "To thee, O best of Aṅgirases, all people with fair dwellings, severally, O Agni, have turned, in order to gain their wish."[1] (Consequently) he (i.e., Agni) puts into him (i.e., the Sacrificer) his desires. Being fulfilled with their objects of desire, his desires accompany him on his journey. He becomes full of fiery energy, full of manly power.[2]

(*b*) This is indeed the continuity of the sacrifice if, after having added fuel to the sacred fires, one enters on the religious vow. (But) if that one (i.e., the Āhavanīya fire) becomes extinguished, that is an interruption of this (i.e., of the sacrifice). (Therefore, in that case,) having carried (again) that (fire) forwards, he (the Adhvaryu, acting for the Sacrificer,) should worship it with the mind. Verily Prajāpati is the mind, and the sacrifice is derived from Prajāpati. (Consequently, by worshipping the fire with the mind,) he (re-)establishes the continuity of the sacrifice by means of the mind. He says: "Existence (*bhūḥ*)." Verily Prajāpati is the one who has come into (real) existence (*bhūtaḥ*). (Consequently) he (the Sacrificer) obtains prosperity (*bhūtim*).[3]

(*c*) Verily an Āhitāgni (i.e., a Sacrificer who has performed the rite of the establishment of the sacred fires) is deprived of his manly power, of his manly energy, if his fire (i.e., his Āhavanīya fire) falls down while burning. If it should fall down, while burning, at such a distance (from its original fire place) that one could hit it with the *śamyā* (the wooden peg) (i.e., by throwing the *śamyā* on it), he (the Adhvaryu) should collect that fire with the formula: "Here is one (light) for thee; beyond is one (light) for thee; do thou unite with the third light. Causing this union of thy body (with that light), be lovely in the beloved highest birthplace of the gods."[4] (And after that, the Adhvaryu should put that fire back on its fire place.) (By reciting that formula) it is indeed with the Bráhman (i.e., with the holy power of the sacred word) that he collects that fire. This is the atonement-rite for that.[5]

(*d*) If it (i.e., the fire) should fall, while burning, at a greater distance, he (the Sacrificer) should go after that, and settle (there where the fire has fallen). This indeed is the atonement-rite for that.[6]

(*e*) Verily milk enters into the plants and into the cows of that one for the oblation of whom the calves are driven away (from the cows) and (still) suck (the cows). If he (the Adhvaryu, acting for the Sacrificer,) should milk them (i.e., the cows) (in order to get the milk for the *sāṃnāyya*-offering of the new-moon sacrifice), he would sacrifice with a sacrificial substance which has already been used (since the calves have sucked the cows). (On the other hand) if he should not milk them, he would omit a portion of the sacrifice. (Therefore) he should offer a rice-gruel to Vāyu. Verily the provider of milk is Vāyu. It is he who gives the milk to him (i.e., to the Sacrificer). (And) the plants are milk, (and) milk is milk. (Consequently, by offering to Vāyu a rice-gruel, which is made of the product of rice-plants and of milk) it is by means of milk that he (the Adhvaryu) obtains milk for him (i.e., for the Sacrificer). Then (the next day), he should (again) drive the calves

[1] = RV. 8.43.18. *Cf.* TS. 1.3.14.3.

[2] *Cf.* Āp. 9.1.8.

[3] *Cf.* Āp. 9.1.11.

[4] *Cf.* RV. 10.56.1 and AV. 18.1.7.

[5] The interpretation of this text is difficult because of its conciseness. My interpretation, which follows that of Caland, is based on the examination of the parallel texts (Baudh. 29.10; Āp. 9.1.17–18; Āśv. 3.10.9). From these texts it appears that this atonement-rite and the following one should be performed when an Āhitāgni, leaving his home, carries away with him his sacred fires, and it happens that, during the transportation, the fire (the Āhavanīya fire according to Āśvalāyana) falls down.—These two atonement-rites are connected with the *agnihotra*. But it seems that, for the author of the Tait.-Br., they are considered as being also connected with the new-moon sacrifice because the *sāṃnāyya*-offering at the new-moon sacrifice is connected with the performance of the *agnihotra*.

[6] According to Āp. 9.1.18–19, the Adhvaryu, acting for the Sacrificer, should offer, there where the fire has fallen, a sacrificial cake on eight potsherds to Agni Pathikṛt (i.e., Agni who prepares the way).

away (from the cows) for the subsequent oblation (i.e., for the *sāṃnāyya*-offering of the subsequent normal new-moon sacrifice). This is the atonement-rite for that.[7]

(*f*) Verily, of the two groups of gods (namely those who come in the evening and those who come in the morning), he deprives of their share those gods who come to the house of the Sacrificer in the evening, he whose sacrificial substance (i.e., the milk), after it has been milked in the evening, undergoes damage (i.e., is spoilt). (Consequently, if the milk that has been milked in the evening for the *sāṃnāyya*-offering, which is to be offered to Indra, the next day, is spoilt,) he (the Sacrificer, through the mediation of the Adhvaryu,) should scatter grains of rice (for a cake) for Indra, and then spend the night fasting near the sacred fire. Verily the plants (which produce the grains of rice) are milk. (Consequently) it is after having taken hold of milk, after having seized it, that he spends the night fasting near the sacred fire. The milk that should be (milked) in the morning, one should cook. And the sacrificial cake prepared for Indra should be the other (milk) (i.e., should be a substitute for the milk milked in the evening). (Thus) he (the Adhvaryu) puts together for him (i.e., for the Sacrificer) the two (portions of sacrificial substance) that belong to Indra. (For) verily the plants (that produce the grains of rice) are milk, (and) milk is milk. (Consequently, by offering a cake made of the product of plants,) it is by means of milk that he (the Adhvaryu) obtains milk for him (i.e., for the Sacrificer). Then (the next day), he should (again) drive the calves away (from the cows) for the subsequent oblation (i.e., for the *sāṃnāyya*-offering of the subsequent normal new-moon sacrifice). This is the atonement-rite for that.[8]

(*g*) Verily he deprives of their share both (groups of gods), (namely) those who come to the house of the Sacrificer in the evening and those who come in the morning, he of whom the two sacrificial substances (i.e., the two kinds of milk used for the preparation of the *sāṃnāyya*-offering) undergo damage (i.e., are spoilt). (Therefore, in this case,) he (the Adhvaryu, acting for the Sacrificer,) should offer a porridge of rice, of five *śarāvas*,[9] to Indra. (And, first,) he should offer an oblation to Agni, the first of the deities. (By doing so) he gladdens the deities who have Agni at their head. Verily some deities follow Agni, and some follow Indra. (By offering an oblation to Agni and a porridge of rice to Indra,) he gladdens both (groups of deities). —Verily the plants (that produce the grains of rice) are milk, (and) milk is milk. (Consequently, by offering to Indra, instead of the two kinds of milk, a porridge made of rice, the product of plants, and milk,) it is by means of milk that he (the Adhvaryu) obtains milk for him (i.e., for the Sacrificer). Then (the next day), he should (again) drive the calves away (from the cows) for the subsequent oblation (i.e., for the *sāmnāyya*-offering of the subsequent normal new-moon sacrifice). This is the atonement-rite for that.[10]

(*h*) Verily one-half is lost of the sacrifice of that one whose wife, on the day of the religious vow (i.e., on the day before the performance of the sacrifice) is untouchable (because she is menstruating). (Consequently, in that case,) he (the Sacrificer) should perform the sacrifice (only) after having kept her away (from the place of the sacrifice). (Nevertheless) he performs the whole sacrifice. (For that purpose) he should invite her to come to him (with this formula): "I am that one (i.e., the Sky), thou art this one (i.e., the Earth).[11] I am the Sky, thou art the Earth. I am the Sāman, thou art the Ṛc. Come! As such, let us unite. Let us put together our seed, in order to obtain a male child, a son, prosperity, good offspring, and abundance of brave men." (By reciting this formula,) he invites her to the half (of the sacrifice) (and the sacrifice becomes whole). This is the atonement-rite for that.[12]

[7] *Cf.* Āp. 9.1.23–24.

[8] *Cf.* Āp. 9.1.25–28.

[9] The *śarāva* is a measure of capacity. The word may be translated by "panful."

[10] *Cf.* Āp. 9.1.31. According to Āp. 9.1.31, the oblation offered to Agni is a sacrificial cake offered on eight potsherds. According to Baudh. 27.13, one should proceed with the offering to Indra after having first offered the oblation to Agni.

[11] The reading *ámū hám* is well established, but it is difficult to explain it satisfactorily. The reading of the Atharvaveda is *ámo 'hám*. I think that *ámū*, like *ámo*, has the value of *asáu*, the nominative singular masculine of the demonstrative pronoun, the accusative of which is *amúm*, and that it means "that one." My interpretation is based on the fact that the following sentence of the formula is "I am the Sky, thou art the Earth." It is uncertain, however, because the demonstrative pronoun that designates the earth is usually *iyám* and not *sā*.

[12] *Cf.* Āp. 9.2.1–3.

3.7.2

(*a*) yád víṣṣaṇṇena (*corr.*: víṣyaṇṇena) juhuyā́t, áprajā apaśúr yájamānaḥ syā́t; yád ánāyatane ninā́yet, anāyatanáḥ syā́t; prājāpatyā́ya reā́ valmīkavapā́yām ávanayet; prājāpatyó vái valmīkaḥ, yajñáḥ prajā́patiḥ; prajā́patāv evá yajñáṃ prátiṣṭhāpayati; bhū́r íty āha; bhūtó vái prajā́patiḥ [1], bhū́tim evó 'paiti; tát kṛtvā́, anyā́ṃ dugdhvā́ púnar hotavyàm; sái 'vá tátaḥ prā́yaścittiḥ.

(*b*) yát kīṭā́vapannena juhuyā́t, áprajā apaśúr yájamānaḥ syā́t; yád ánāyatane ninā́yet, anāyatanáḥ syā́t; madhyaménа parṇéna dyā́vāpṛthivyòr reā́ 'ntaḥparidhí ninayet; dyā́vāpṛthivyór evái 'nat prátiṣṭhāpayati [2]; tát kṛtvā́, anyā́ṃ dugdhvā́ púnar hotavyàm; sái 'vá tátaḥ prā́yaścittiḥ.

(*c*) yád ávavṛṣṭena juhuyā́t, áparūpam asyā́ "tmáñ jāyeta, kilā́so vā syā́d arśasó vā; yát práty eyā́t, yajñáṃ vícchindyāt; sá juhuyā́t, mitró jánān kalpayati prajā́nán [3], mitró dadhāra pṛthivím utá dyā́m, mitráḥ kṛṣṭír ánimiṣā 'bhícaṣṭe, satyā́ya havyáṃ ghṛtávaj juhoté 'ti; mitréṇai 'vái 'nat kalpayati; tát kṛtvā́, anyā́ṃ dugdhvā́ púnar hotavyàm; sái 'vá tátaḥ prā́yaścittiḥ.

(*d*) yát pū́rvasyām āhutyāñ́ hutā́yām úttarā "hutíḥ skándet, dvipā́dbhiḥ paśúbhir yájamāno vyṛ́dhyeta; yád úttarayā́ 'bhí juhuyā́t [4], cátuṣpādbhiḥ paśúbhir yájamāno vyṛ́dhyeta; yátra véttha vaṇaspate devā́nāṃ gúhyā nā́māni, tátra havyā́ni gāmayé 'ti, vānaspatyā́ya reā́ samídham ādhā́ya, tū́ṣṇīm evá púnar juhuyā́t; vánaspátinai 'vá yajñásyā "rtā́ṃ cā́ 'nārtā́ṃ cā́ "hutī́ vídādhāra; tát kṛtvā́, anyā́ṃ dugdhvā́ púnar hotavyàm; sái 'vá tátaḥ prā́yaścittiḥ.

(*e*) yát purā́ prayā́jébhyaḥ prā́ñ áṅgāraḥ skándet, adhvaryáve ca yájamānāya cā́ 'kaṁ syā́t [5]; yád dakṣiṇā́, brahmáṇe ca yájamānāya cā́ 'kaṁ syā́t; yát pratyák, hótre ca pátniyai ca yájamānāya cā́ 'kaṁ syā́t; yád údaṅ, agnídhe ca paśúbhyaś ca yájamānāya cā́ 'kaṁ syā́t; yád abhijuhuyā́t, rudró 'sya paśū́n ghātukaḥ syā́t; yán nā́ 'bhijuhuyā́t, áśāntaḥ práhriyeta [6]; sruvásya búdhnena 'bhinídadhyāt, má tamo mā́ yajñás taman má yájamānas tamat, námas te astv āyaté, námo rudra parāyaté, námo yátra niṣídasi, amúṃ má hiṁsīr amúṃ má hiṁsīr íti yéna skándet, táṃ práharet; sahásraśṛṅgo vṛṣabhó jātávedāḥ, stómapṛṣṭho ghṛtávānt suprátīkaḥ, má no hāsīn metthitó nét tvā jáhāma, goposáṃ no vīraposáṃ ca yacché 'ti, bráhmaṇai 'vái 'naṃ práharati; sái 'vá tátaḥ prā́yaścittiḥ [7].

(*a*) If he (the Adhvaryu, acting for the Sacrificer,) should perform the sacrifice with an offering (of milk) that (when cooked,) has flowed out (of the vessel), the Sacrificer would be without offspring and without cattle. If he (the Adhvaryu) should pour it out in a place that is not its proper resting place, he (the Sacrificer) would be without a proper resting place (i.e., homeless). (Therefore, in that case,) he (the Adhvaryu) should, with the stanza that is addressed to Prajāpati,[13] pour it out on an ant-hill. The ant-hill belongs to Prajāpati.[14] (And) Prajāpati is the sacrifice. (Consequently, by doing thus,) he puts the sacrifice into Prajāpati (i.e., in its proper place).—He (the Adhvaryu, acting for the Sacrificer,) says: "Existence (*bhūḥ*)." Verily Prajāpati is the one who has come into real existence (*bhūtaḥ*). (Consequently) he (the Adhvaryu) obtains prosperity (*bhūtim*) (for the Sacrificer). Having done that, and having milked another (cow) (i.e., having caused another cow to be milked), he should offer the oblation anew (i.e., recommence the sacrifice). This is the atonement-rite for that.[15]

(*b*) If he (the Adhvaryu, acting for the Sacrificer,) should perform the sacrifice with an offering (of milk) in which a worm (or an insect) has dropped, the Sacrificer would be without offspring and without cattle. If he (the Adhvaryu) should pour it out in a place that is not its proper resting place, he (the Sacrificer) would be without a proper resting place (i.e., homeless). (Therefore, in that case,) he (the Adhvaryu) should, with the stanza that is addressed to Heaven and Earth,[16] pour it out, by means of the middle part of a (trifoliolate) *palāśa* leaf, within the enclosing-sticks. (By doing thus,) he puts it in Heaven and Earth (i.e., in its proper place). Having done that, and having milked another (cow) (i.e.,

[13] The stanza that is addressed to Prajāpati is RV. 10.121.10: "O Prajāpati, none other than thou encompasseth all these creatures; for whatever object of desire we sacrifice to thee, let that be ours. May we be lords of riches."

[14] According to TS. 5.1.2.5, Prajāpati is this earth, and the ant-hill is its ear.

[15] *Cf.* Āp. 9.2.4.—This atonement-rite and the following ones are connected with the *agnihotra*. But it seems that, for the author of the Tait.-Br., they are also considered as being connected with the new-moon sacrifice because the preparation of the *sāṃnāyya*-offering of the new-moon sacrifice is connected with the performance of the *agnihotra*.

[16] The stanza that is addressed to Heaven and Earth is RV. 1.22.13 = TS. 3.3.10.h: "May the great Heaven and the Earth mingle (i.e., prepare) for us the sacrifice. May they further us with their support."

having caused another cow to be milked), he should offer the oblation anew (i.e., recommence the sacrifice). This is the atonement-rite for that.[17]

(*c*) If he (the Adhvaryu, acting for the Sacrificer,) should perform the sacrifice with an offering (of milk) on which drops of rain have fallen, deformity would be produced on the body of the Sacrificer; he would be leprous or afflicted with hemorrhoids. (On the other hand,) if he (the Adhvaryu) should go back (to the Gārhapatya fire place, in order to fetch another portion of milk), he would interrupt the sacrifice. (Therefore, in that case,) he should offer an oblation with (this formula): "Mitra, he who knows, causes men to be fit; Mitra regards men with unwinking eyes. To the true one do you offer an oblation rich in clarified butter."[18] (By doing thus,) thanks to Mitrā, he (the Adhvaryu) causes that (offering) to be fit (for oblation). Having done that, and having milked another (cow) (i.e., having caused another cow to be milked), he should offer the oblation anew (i.e., recommence the sacrifice). This is the atonement-rite for that.[19]

(*d*) (For the performance of the *agnihotra*, the Adhvaryu, acting for the Sacrificer, should pour out two libations of milk on the kindling-stick that he has put on the Āhavanīya fire.)

If, after the first libation has been poured out, the second libation should be spilt (i.e., lost), the Sacrificer would be deprived of his two-footed domestic animals (i.e., his servants). If he (the Adhvaryu) should pour out the second libation upon the first one, the Sacrificer would be deprived of his four-footed domestic animals (i.e., his cattle). (In both cases) he (the Adhvaryu) should put a kindling-stick (on the Āhavanīya fire) with the stanza that is addressed to the lord of the forest (i.e., the tree) (namely): "There where thou knowest, O lord of the forest, the secret names of the gods, there do thou bring our oblations;"[20] and then he should silently (i.e., without any formula) offer again (i.e., offer the second libation). (By doing so) it is by means of the lord of the forest (i.e., by means of the kindling-stick) that he supports separately the two libations of the sacrifice, the one that has undergone damage and the one that is undamaged. Having done that, and having milked another (cow) (i.e., having caused another cow to be milked), he should offer the oblation anew (i.e., recommence the sacrifice). This is the atonement-rite for that.[21]

(*e*) If, before the *prayājas* (the fore-offerings), a glowing charcoal should fall (outside the enclosing-sticks) towards the east, that would be unhappiness for the Adhvaryu, and for the Sacrificer; if (it should fall) towards the south, it would be unhappiness for the Brahmán, and for the Sacrificer; if (it should fall) towards the west, it would be unhappiness for the Hotar, for the (Sacrificer's) wife, and for the Sacrificer; if (it should fall) towards the north, it would be unhappiness for the Āgnīdhra, for the cattle (of the Sacrificer), and for the Sacrificer.—If he (the Adhvaryu, acting for the Sacrificer,) should make an oblation upon it (i.e., upon that glowing charcoal), Rudra would kill his cattle (i.e., the cattle of the Sacrificer). (But) if he (the Adhvaryu, acting for the Sacrificer,) should not make an oblation on it, that glowing charcoal would be thrown away without having been appeased. (Therefore, in those cases,) he (the Adhvaryu) should cover it (i.e., the charcoal) with the lowest part of the *sruvā* spoon, saying: "Be thou not suffocated; let the sacrifice not be suffocated; let the Sacrificer not be suffocated."—"Homage to thee, (O Rudra,) when thou art coming; homage to thee, O Rudra, when thou art going away. Homage (to thee) there where thou art sitting down." (Then) with (the words) "Do not hurt that one; do not hurt that one!" etc.,[22] he should throw the charcoal in that direction wherefrom it would have fallen. He throws it (back) (into the fire) with this formula: "The bull with a thousand horns, the god who knows all creatures, and whose back is a song of praise, who is endowed with clarified butter, and who has a beautiful face,—let him not leave us after having been united (with us), (and) let us not leave thee!—Give us thriving of cattle and thriving of manly sons." This is the atonement-rite for that.[23]

3.7.3

(*a*) ví vā eṣá indriyéṇa vīryèṇa rdhyate, yásyā "hitāgner agnír mathyámāno ná jāyate; yátrā

[17] *Cf.* Āp. 9.2.5.

[18] *Cf.* TS. 3.4.11.q = RV. 3.59.1.

[19] *Cf.* Āp. 9.2.6.

[20] = RV. 5.5.10.

[21] *Cf.* Āp. 9.2.7.

[22] I.e., according to the case: "Do not hurt the Adhvaryu; do not hurt the Sacrificer."—"Do not hurt the Brahmán; do not hurt the Sacrificer."—"Do not hurt the Hotar; do not hurt the (Sacrificer's) wife; do not hurt the Sacrificer."—"Do not hurt the Āgnīdhra; do not hurt the cattle (of the Sacrificer); do not hurt the Sacrificer." *Cf.* Āp. 9.2.9.

[23] *Cf.* Āp. 9.2.9 and 9.3.1.

'nyáṃ páśyet, táta āhṛ́tya hotavyàm; agnáv evá 'syā 'gnihotráṁ hutáṃ bhavati.

(*b*) yády anyáṃ ná vindét, ajáyāṁ hotavyàm; āgneyí vá eṣá, yád ajá; agnáv evá 'syā 'gnihotráṁ hutáṃ bhavati [1].

(*c*) ajásya tú ná 'śnīyāt; yád ajásyā' śnīyāt, yáṃ evá 'gnáv áhutiṃ juhuyā́t, táṃ adyāt; tásmād ajásya ná "śyam.

(*d*) yády ajáṃ ná vindét, brāhmaṇásya dákṣiṇe háste hotavyàm; eṣá vá agnír vaiśvānaráḥ, yád brāhmaṇáḥ; agnáv evá 'syā 'gnihotráṁ hutáṃ bhavati [2]; brāhmaṇáṃ tú vasatyài ná 'parundhyāt; yád brāhmaṇáṃ vasatyā́ aparundhyā́t, yásmin evá 'gnáv áhutiṃ juhuyā́t, táṃ bhāgadhéyena vyàrdhayet; tásmād brāhmaṇó vasatyài ná 'parúdhyaḥ.

(*e*) yádi brāhmaṇáṃ ná vindét, darbhastambé hotavyàm; agnivā́n vái darbhastambáḥ; agnáv evá 'syā 'gnihotráṁ hutáṃ bhavati; darbhāṁs tú ná 'dhyāsīta [3]; yád darbhā́n adhyā́sīta, yáṃ evá 'gnáv áhutiṃ juhuyā́t, táṃ ádhyāsīta; tásmād darbhā́ ná 'dhyāsitavyāḥ.

(*f*) yádi darbhā́n ná vindét, apsú hotavyàm; ápo vái sárvā devátāḥ; devátāsv evá 'syā 'gnihotráṁ hutáṃ bhavati; ápas tú ná páricakṣīta; yád ápaḥ paricákṣīta [4], yáṃ evá 'psv áhutiṃ juhuyā́t, táṃ páricakṣīta; tásmād ápo ná paricákṣyāḥ.

(*g*) médhyā ca vá etásyā 'medhyā ca tanúvau sáṁsṛjyete, yásyā́ "hitāgner anyáir agníbhir agnáyaḥ saṁsṛjyánte; agnáye vivicaye puroḍā́śam aṣṭā́kapālaṃ nírvapet; médhyāṃ cai 'vá 'syā 'medhyáṃ ca tanúvau vyávartayati.

(*h*) agnáye vratápataye puroḍā́śam aṣṭā́kapālaṃ nírvapet; agníṃ evá vratápatiṁ svéna bhāgadhéyenó 'padhāvati; sá evái 'naṃ vrátam álambhayati [5].

(*i*) gárbhaṁ srávantam agadám akaḥ, agnír índras tváṣṭā bṛ́haspátiḥ, pṛthivyáṃ ávacuścotai 'tát, nā́ 'bhi prā́pnoti nírṛtiṃ parācáiḥ; réto vá etád vā́jinam áhitāgneḥ, yád agnihotrám; tád yát srávet, réto 'sya vā́jinaṁ sravet; gárbhaṁ srávantam agadám akar íty āha; réta evá 'smin vā́jinaṃ dadhāti [6].

(*j*) agnír íty āha, agnír vái retodhā́ḥ, réta evá tád dadhāti; índra íty āha, indriyám evá 'smin dadhāti; tváṣṭé 'ty āha, tváṣṭā vái paśūnā́ṃ mithunā́naṁ rūpakṛ́t, rūpám evá paśúṣu dadhāti; bṛ́haspátir íty āha, bráhma vái devā́nāṃ bṛ́haspátiḥ, bráhmaṇai 'vá 'smai prajā́ḥ prájanayati.

(*k*) pṛthivyáṃ ávacuścotai 'tád íty āha, asyā́m evái 'nat prátiṣṭhāpayati.

(*l*) nā́ 'bhi prā́pnoti nírṛtiṃ parācáir íty āha, rákṣasām ápahatyai [7].

(*a*) Verily an Āhitāgni (i.e., a Sacrificer who has performed the rite of the establishment of the sacred fires) is deprived of his manly power, of his manly energy, if the fire is not produced while it is churned (i.e., while the churning takes place). (Therefore, in that case,) he (the Adhvaryu, acting for the Sacrificer,) should look for (whatsoever) another (fire), and having fetched (that other fire), he should offer the oblation (on it). (If that is done,) it is on the fire, indeed, (as it is prescribed,) that his *agnihotra* (i.e., the *agnihotra* of the Sacrificer) is offered.[24]

(*b*) If he (the Adhvaryu) should not find another (fire), he should offer the oblation on a she-goat (i.e., according to Āpastamba, on the right ear of a she-goat). Verily this one, the she-goat, is of Agni's (the fire's) nature. (Consequently, when the oblation is offered on a she-goat,) it is on the fire, indeed, (as it is prescribed,) that his *agnihotra* (i.e., the *agnihotra* of the Sacrificer) is offered.[25]

(*c*) But (thereafter) he (the Sacrificer) should not eat goat's flesh (nor drink goat's milk). If he should eat goat's flesh (or drink goat's milk), he would eat the oblation that he (through the mediation of the Adhvaryu) would offer on the fire. Therefore he should not eat goat's flesh (nor drink goat's milk).[26]

(*d*) If he (the Adhvaryu, acting for the Sacrificer,) should not find a she-goat, he should offer the oblation on the right hand of a Brāhmaṇa. Verily this one, the Brāhmaṇa, is Agni Vaiśvānara. (Consequently, when the oblation is offered on the right hand of a Brāhmaṇa,) it is on the fire, indeed, (as it is prescribed,) that his *agnihotra* (i.e., the *agnihotra* of the Sacrificer) is offered. But (thereafter) he (the Sacrificer) should not refuse lodging to a Brāhmaṇa. If he should refuse lodging to a Brāhmaṇa, he would deprive from its share the fire on which he (through the mediation of the Adhvaryu) would offer the oblation. Therefore, he should not refuse lodging to a Brāhmaṇa.[27]

(*e*) If he (the Adhvaryu, acting for the Sacri-

[24] *Cf.* Āp. 9.3.3.—This atonement-rite and the following ones are connected with the *agnihotra*; but they are also considered as connected with the new-moon sacrifice because the preparation of the *sāṃnāyya*-offering is connected with the performance of the *agnihotra*.

[25] *Cf.* Āp. 9.3.5.

[26] *Cf.* Āp. 9.3.6.

[27] *Cf.* Āp. 9.3.7–8.

ficer,) should not find a Brāhmaṇa, he should offer the oblation on a bunch of Darbha grass. Verily the bunch of Darbha grass is fiery (i.e., containing fire). (Consequently, when the oblation is offered on a bunch of Darbha grass,) it is on the fire, indeed, (as it is prescribed,) that his *agnihotra* (i.e. the *agnihotra* of the Sacrificer) is offered. But (thereafter) he (the Sacrificer) should not sit on Darbha grass. If he should sit on Darbha grass, he would sit on the very oblation which he (through the mediation of the Adhvaryu) would offer on the fire. Therefore, he should not sit on Darbha grass.[28]

(*f*) If he (the Adhvaryu, acting for the Sacrificer,) should not find Darbha grass, he should offer the oblation on the waters. Verily the waters are all the deities. (Consequently, when the oblation is offered on the waters,) it is indeed on (all) the deities (including Agni, the Fire,) that his *agnihotra* (i.e., the *agnihotra* of the Sacrificer) is offered. But (thereafter) he should not censure the waters. If he should censure the waters, he would censure the very oblation which he (through the mediation of the Adhvaryu) would offer on the waters. Therefore, he should not censure the waters.[29]

(*g*) Verily the two selves of an Āhitāgni,[30] namely, the one that is fit for the performance of the rites, and the one that is not fit for the performance of the rites, mix together if his sacred fires mix together with other fires. (Therefore, in that case,) he (the Adhvaryu, acting for the Sacrificer,) should offer to Agni Vivici (Agni, the Divider,) a sacrificial cake on eight potsherds. (By doing so,) he separates the two bodies of him (i.e., of the Āhitāgni), namely, the one that is fit for the performance of the rites, and the one that is not fit for that.[31]

(*h*) He (the Sacrificer, through the mediation of the Adhvaryu,) should offer to Agni Vratapati (Agni, the lord of religious vows,) a sacrificial cake on eight potsherds. (By doing so) he approaches (for assistance) Agni Vratapati with his own share, (and) he (Agni Vratapati) makes him take hold of his vow.[32]

(*i*) (The Adhvaryu says:) "They have made free from injury the down-flowing embryo (i.e., the down-flowing seminal fluid),—(the gods) Agni, Indra, Tvaṣṭar, Bṛhaspati. This (i.e., the sacrificial substance) has flowed down on the earth; (but) it does not reach Nirṛti (the goddess of destruction), beyond."[33] Verily the *agnihotra* (i.e., the sacrificial substance to be offered at the *agnihotra*) is the seminal fluid, the manly power, of the Āhitāgni (i.e., the Sacrificer). If that should flow out, the seminal fluid, the manly power, of him (i.e., of the Āhitāgni) would flow out. (Therefore, if the sacrificial substance to be offered at the *agnihotra* flows out,) he (the Adhvaryu) says: "They have made free from injury the down-flowing embryo." (By saying that) he puts seminal fluid, manly strength, into him (i.e., into the Sacrificer).

(*j*) He says: "Agni." Verily the giver of seminal fluid is Agni. (Consequently, by saying that,) he gives seminal fluid (to the Sacrificer). He says: "Indra." (By saying that,) he gives manly power (*indríyam*) to him (i.e., to the Sacrificer). He says: "Tvaṣṭar." Verily the god who gives forms to the pairs of domestic animals is Tvaṣṭar. (Consequently, by saying that,) he (the Adhvaryu) gives forms to the domestic animals. He says: "Bṛhaspati." Verily Bṛhaspati, among the gods, is the Bráhman (the holy power of the sacred word). (Consequently, by saying that,) it is by means of the Bráhman that he (the Adhvaryu), for the benefit of him (i.e., of the Sacrificer), causes the creatures to procreate.

(*k*) He says: "This has flowed down on the earth." (By saying that,) he firmly establishes this (i.e., the sacrificial substance of the *agnihotra*, i.e., the seminal fluid, i.e., the offspring, of the Sacrificer) on this (earth).

(*l*) He says: "(But) it does not reach Nirṛti (the goddess of destruction), beyond." (He says that) in order to drive the Rakṣases away.

3.7.4

(*a*) yáḥ purástāt prasrávanti, upáriṣṭāt sarvátaś ca yáḥ, tábhī raśmípavitrābhiḥ, śraddhắṃ yajñám árabhe.

(*b*) dévā gātuvidaḥ, gātúṃ yajñắya vindata; mánasas pátinā devéna, vātād yajñắḥ práyujyatām.

(*c*) tṛtíyasyai diváḥ, gāyatriyắ sóma ábhṛtaḥ

[28] *Cf.* Āp. 9.3.9–10.

[29] *Cf.* Āp. 9.3.11–14.

[30] I.e., a Sacrificer who has performed the rite of the establishment of the sacred fires.

[31] *Cf.* Āp. 9.3.18.

[32] *Cf.* Āp. 9.3.16.—According to Sāyaṇa, the Sacrificer should offer this cake to Agni Vratapati if he has vowed not to eat goat's flesh, or not to refuse lodging to a Brāhmaṇa, or not to sit on Darbha grass, or not to censure the waters.

[33] According to Āp. 9.4.1, this formula should be recited over the *agnihotrasthālī* (the kettle that contains the milk of the *agnihotra*) if it begins to leak.

[1]; somapīthāya sáṃnayitum, vákalam ántaram ādade.

(*d*) ấpo devīḥ śuddhấḥ stha; imấ pấtrāṇi śundhata; upātaṅkyấya devấnām, parṇavalkám utá śundhata.

(*e*) páyo gṛhéṣu páyo aghniyấsu, páyo vatséṣu; páya índrāya havíṣe dhriyasva; gāyatrī́ parṇavalkéna, páyaḥ sómaṃ karotv imám [2].

(*f*) agníṃ gṛhṇāmi surátham yó mayobhúḥ, yá udyántam āróhati sū́ryam áhne, ādityáṃ jyótiṣāṃ jyótir uttamám; śvó yajñấya ramatāṃ devátābhyaḥ.

(*g*) vásūn rudrấn ādityấn, índreṇa sahá devátāḥ, tấḥ pū́rvaḥ párigṛhṇāmi, svá āyátane manīṣáyā.

(*h*) imấṃ ū́rjaṃ pañcadaśíṃ yé práviṣṭāḥ, tấn devấn párigṛhṇāmi pū́rvaḥ [3]; agnír havyavấḍ ihá tấn ávahatu; paurṇamāsáṁ havír idám eṣāṃ máyi.—āmāvāsyàṁ havír idám eṣāṃ máyi.

(*i*) antarā́ 'gni paśávaḥ, devasaṁsádam ágaman; tấn pū́rvaḥ párigṛhṇāmi, svá āyátane manīṣáyā.

(*j*) ihá prajā́ viśvárūpā ramantām, agníṃ gṛhápatim abhí saṃvásānāḥ; tấḥ pū́rvaḥ párigṛhṇāmi [4], svá āgátane manīṣáyā.

(*k*) ihá paśávo viśvárūpā ramantām, agníṃ gṛhápatim abhí saṃvásānāḥ; tấn pū́rvaḥ párigṛhṇāmi, svá āyátane manīṣáyā.

(*l*) ayáṃ pitṛṇấṃ agníḥ, ávāḍ ḍhavyấ pitṛ́bhya ấ; táṃ pū́rvaḥ párigṛhṇāmi; áviṣaṃ naḥ pitúṃ karat.

(*m*) ájasraṃ tvấṁ sabhāpālấḥ [5], vijayábhāgaṁ sámindhatām; ágne dīdā́ya me sabhya, víjityai śarádaḥ śatám.

(*n*) ánnam āvasathíyam, abhíharāṇi śarádaḥ śatám; āvasathé śríyaṃ mántram, áhir budhníyo níyacchatu.

(*o*) idám ahám agnijyeṣṭhebhyaḥ, vásubhyo yajñấṃ prábravīmi.—idám ahám índrajyeṣṭhebhyaḥ [6], rudrébhyo yajñấṃ prábravīmi.—idám ahám váruṇajyeṣṭhebhyaḥ, ādityébhyo yajñấṃ prábravīmi.

(*p*) páyasvatīr óṣadhayaḥ, páyasvad vīrúdhāṃ páyaḥ; apấṃ páyaso yát páyaḥ, téna mấm indra sáṁsṛja.

(*q*) ágne vratapate vratáṃ cariṣyāmi, tác chakeyaṃ tán me rādhyatām.—vā́yo vratapata (*corr.*: vratapate.—) ấditya vratapate [7].—vratā́nāṃ vratapate vratáṃ cariṣyāmi, tác chakeyaṃ tán me rādhyatām.

(*r*) imấṃ prā́cīm údīcīm, íṣam ū́rjam abhí sáṁskṛtām, bahuparṇám áśuṣkāgrām, hárāmi paśupấm ahám.

(*s*) yát kṛ́ṣṇo rū́pāṃ kṛtvấ, prāviśas tvấṃ vánaspátīn, tátas tvấm ekaviṁśatidhấ, sáṃbharāmi susaṃbhṛ́tā [8].

(*t*) trín paridhíṁs tisráḥ samídhaḥ, yajñā́yur anusaṃcarấn, upaveṣáṃ mékṣaṇaṃ dhṛ́ṣṭim, sáṃbharāmi susaṃbhṛ́tā.

(*u*) yấ jātấ óṣadhayaḥ, devébhyas triyugáṃ purấ, tā́sāṃ párva rādhyāsam, paristarám āháran.

(*v*) apấṃ médhyaṃ yajñíyam, sádevaṁ śivám astu me [9]; ā́cchettā́ vo mấ riṣam, jívāni śarádaḥ śatám.

(*w*) áparimitānāṃ párimitāḥ, sáṃnahye sukṛtā́ya kám; éno mấ nígām katamác canā́ 'hám; púnar utthā́ya bahulā́ bhavantu.

(*x*) sakṛdā́cchinnáṃ barhír ū́rṇāmṛdu, syonáṃ pitṛ́bhyas tvā bharāmy ahám; asmínt sīdantu me pitáraḥ somyā́saḥ, pitā́mahāḥ prápitāmahāś cā 'nugáiḥ sahá [10].

(*y*) trivṛ́t palāśé darbhā́ḥ, íyān prādeśásaṃmitaḥ, yajñé pavítraṃ pótṛtamam, páyo havyáṃ karotu me.

(*z*) imáu prāṇāpānáu, yajñásyā 'ṅgāni sarvaśáḥ, āpyāyáyantau sáṃcaratām, pavítre havyaśódhane.

(*aa*) pavítre stho vaiṣṇavī́; vāyúr vāṃ mánasā punātu [11].

(*bb*) ayáṃ prāṇáś cā 'pānáś ca, yájamānam ápigacchatām, yajñé hy ábhūtāṃ pótārau, pavítre havyaśódhane.

(*cc*) tváyā védiṃ vividuḥ pṛthivím, tváyā yajñó jāyate viśvadā́niḥ; ácchidraṃ yajñám ánveṣi vidvān; tváyā hótā sáṃtanoty ardhamā́sān.

(*dd*) trayastriṁśó 'si tántūnām; pavítreṇa sahá "gahi [12]; śivé 'yáṁ rā́jjur abhidhānī́; aghniyām úpasevatām.

(*ee*) áprasraṁsāya yajñásya, ukhé úpadadhāmy ahám; paśúbhiḥ sáṃnītaṃ bibhṛtām, índrāya śṛtáṃ dádhi.

(*ff*) upaveṣò 'si yajñā́ya, tvấṃ pariveṣám adhārayan, índrāya havíḥ kṛṇvántaḥ; śivā́ḥ śagmó bhavāsi naḥ [13].

(*gg*) ámṛṇmayaṃ devapātrám, yajñásyā "yuṣi práyujyatām; tiraḥpavitrám átinītāḥ, ā́po dhāraya mā́ 'tiguḥ.

(*hh*) devéna savitró 'tpūtā́ḥ, vásoḥ sū́ryasya raśmíbhiḥ, gā́m dohapavitré rā́jjum, sárvā pā́trāṇi śundhata.

(*ii*) etā́ ácaranti mádhumad dúhānāḥ, prajā́vatīr yaśáso viśvárūpāḥ [14]; bahvír bhávantīr úpa jā́yamānāḥ, ihá va índro ramayatu gā́vaḥ.

(*jj*) pūṣā́ stha.

(*kk*) ayakṣmā́ vaḥ prajáyā sáṁsṛjāmi, rāyás póṣeṇa bahulā́ bhávantīḥ; ū́rjaṃ páyaḥ pínvamānā ghṛtáṃ ca, jívo jívantīr úpa vaḥ sadeyam.

(*ll*) dyáuś ce 'máṃ yajñáṃ pṛthiví ca sáṃduhātām; dhātā́ sómena sahá vā́tena vāyúḥ; yájamānāya dráviṇaṃ dadhātu [15].

(*mm*) útsaṃ duhanti kaláśaṃ cáturbilam, íḍāṃ devíṃ mádhumatiṁ suvarvídam, tád indrāgnī́ jinvataṁ (*corr.*: jinvatāṁ) sūnṛ́tāvat, tád yájamānam amṛtatvé dadhātu.

(*nn*) kā́m adhukṣaḥ prá ṇo brūhi, índrāya havír indriyám.

(*oo*) amū́ṃ yásyāṃ devā́nām, manuṣyā̃ṇām páyo hítam,

(*pp*) bahú dugdhí 'ndrāya devébhyaḥ, havyám ā́pyāyatāṃ púnaḥ [16], vatsébhyo manuṣyèbhyaḥ, punardohā́ya kalpatām.

(*qq*) yajñásya sáṃtatir asi, yajñásya tvā sáṃtatim ánu sáṃtanomi.

(*rr*) ádastam asi víṣṇave tvā, yajñā́yā 'pidadhāmy ahám, adbhír áriktena pā́treṇa, yā́ḥ pū́tāḥ pariśérate.

(*ss*) ayáṃ páyaḥ sómaṃ kṛtvā́, svā́ṃ yónim ápigacchatu [17], parṇavalkā́ḥ pavítram, saumyā́ḥ sómād dhí nírmitāḥ.

(*tt*) imáu parṇā́ṃ ca darbhā́ṃ ca, devā́nāṁ havyaśódhanau, prā́tarveṣāya gopā́ya, víṣṇo havyā́ṁ hí rákṣasi.

(*uu*) ubhā́v agní upastṛṇāté, devā́tā úpavasantu me, ahā́ṃ grāmyā́n úpavasāmi, máhyaṃ gópataye paśū́n [18].

[This chapter and the two following ones contain stanzas and formulas that should be recited at the full-moon and new-moon sacrifices. Most of these stanzas and formulas are to be recited by the Sacrificer or the Adhvaryu.]

(*a*) "With these (waters) which flow forth in front, from above, and from everywhere, which are purified by rays of light, I take hold of faith, (I take hold) of the sacrifice." [34]

(*b*) "O ye gods who know the ways, find the way for the sacrifice. From the wind, let the sacrifice be put in motion by the divine lord of the mind."[35]

(*c*) "From the third heaven the soma was brought hither by the Gāyatrī stanza (which had assumed the form of an eagle). In order to make the mixture (of sweet and sour milk) for the drinking of soma, I seize the inner bast (of a branch of the *parṇa* tree)." [36]

(*d*) "O divine Waters, you are purified. Do you purify these vessels; and, for the rennet (that coagulates the milk) of the gods, purify also the bast of the *parṇa* tree." [37]

(*e*) "The milk (be) in the houses, the milk (be) in the cows, the milk (be) in the calves.[38] O milk, be firm for the oblation offered to Indra. Let the Gāyatrī stanza, by means of the bast of the *parṇa* tree, make the milk into this soma here." [39]

(*f*) "I seize Agni, (the god) who has a good chariot, who causes pleasure, who, for the day, mounts the rising sun, the son of Aditi, the best light of all lights. Let him (i.e., Agni) stay here for the sacrifice of tomorrow, for the benefit of the deities."[40]

(*g*) "First (i.e., before all other Sacrificers), with my prayer, I take hold of the Vasus, the Rudras, the Ādityas, (all) the deities together with Indra, in their own abode."

(*h*) "First (i.e., before all other Sacrificers), I take hold of the gods who have come to this refreshment of the fifteenth day. Let Agni, the conveyer of the oblations, bring them (i.e., the

[34] According to Āp. 4.4.4, this formula should be muttered by the Sacrificer when the Adhvaryu brings the *prāṇīta*-waters forward. *Cf.* Tait.-Br. 3.2.4.b. But, according to Baudh. 2.1: 34.3, this formula and the following one should be muttered by the Sacrificer at the beginning of every sacrifice, just before he pronounces his intention to sacrifice.

[35] According to Āp. 1.1.4, this formula should be muttered by the Adhvaryu when, on the day before the day of the chief offerings, he is about to put fuel on the three sacred fires.

[36] According to Āp. 1.6.8, this formula should be uttered by the Adhvaryu when he takes a splint among the shavings of that branch of *parṇa* tree that has been cut off, and deposits it. This splint, i.e., a piece of the bast of the *parṇa* tree, is to be used as rennet in order to obtain the sour milk for the *sāṃnāyya*-offering. This offering, a mixture of sweet and sour milk, is identified with the soma. *Cf.* Tait.-Br. 3.2.1.a and 3.2.3.i.

[37] According to Āp. 1.11.10, this is the first of the two formulas which the Sacrificer should recite when, on the day before the day of the chief offerings of the new-moon sacrifice, the Adhvaryu sprinkles with water the vessels that are needed for the *sāṃnāyya*-offering. *Cf.* Tait.-Br. 3.2.3.b.

[38] *Cf.* Aitareya-Brāhmaṇa 5.2.8.

[39] This formula is called by Sāyaṇa the *ātañcana-mantra*. It is probable that it should be recited by the Sacrificer when the bast of the *parṇa* tree is put into the sweet milk in order to produce the sour milk for the *sāṃnāyya*-offering. The word *páyas* that stands in front of the words *gṛhéṣu*, *aghnīyā́su*, and *vatséṣu* may be a vocative, but I think that it is a nominative. On the other hand, I think that a new sentence begins with *páya índrāya;* and here *páyaḥ* certainly is a vocative.

[40] According to Āp. 4.1.8, this formula and the two following ones are the formulas which the Sacrificer should recite when, on the day before the day of the chief offerings, fuel is put on the Āhavanīya fire. *Cf.* Āp. 1.1.2.

gods) hither. This oblation of the full-moon day is (here) near me, (ready) for them." [41]—"This oblation of the new-moon day is (here) near me, (ready) for them."

(*i*) "Between the two fires, the domestic animals (i.e.,) the cows) have come to the assembly of the gods. First (i.e., before all other Sacrificers, with my prayer, I take hold of them in their own abode." [42]

(*j*) "Here let the children of the family, of various forms, abide, wrapping themselves into Agni, the lord of the house. First (i.e., before all other Sacrificers), with my prayer, I take hold of them in their own abode." [43]

(*k*) "Here let the domestic animals, of various forms, abide, wrapping themselves into Agni, the lord of the house. First (i.e., before all other Sacrificers), with my prayer, I take hold of them in their own abode."

(*l*) "This is the fire of the Fathers (i.e., of the deceased ancestors); it has conveyed the oblations to the Fathers. First (i.e., before all other Sacrificers), I take hold of it. Let it make our food free from poison." [44]

(*m*) "Let the guardians of the gambling hall inflame thee so that thou shalt not be extinguished, so that thou shalt bring victory. O fire of the gambling hall, do thou shine brightly for my victory, for a hundred autumns." [45]

(*n*) "For a hundred autumns let me bring the food prepared for the guest room. Let (the fire called) the Serpent of the depths keep prosperity, the sacred formula, in the guest room." [46]

(*o*) "Now I announce the sacrifice to the Vasus, of whom the best is Agni.—Now I announce the sacrifice to the Rudras, of whom the best is Indra.—Now I announce the sacrifice to the Ādityas, of whom the best is Varuṇa." [47]

(*p*) "Rich in sap are the plants. Rich in sap is the sap of the plants. With that which is the sap (i.e., the essence) of the sap of the waters, do thou, O Indra, unite me." [48]

(*q*) "O Agni, lord of the vow, I shall observe the vow; may I be able to observe it; may I succeed in it."—"O Vāyu, lord of the vow [, I shall observe the vow; may I be able to observe it; may I succeed in it]."—"O Āditya, lord of the vow [, I shall observe the vow; may I be able to observe it; may I succeed in it]."—"O lord of the vows, I shall observe the vow; may I be able to observe it; may I succeed in it." [49]

(*r*) "This (branch of the *parṇa* tree), the point of which is turned toward northeast, which has been made into sap and strength, which is furnished with many leaves, and which has not a dry tip, I fetch as a protector of the cattle." [50]

(*s*) "Since, (O Agni,) having assumed the form of a black antelope, thou didst enter the trees, out of them I gather thee twenty-one-fold with good gathering." [51]

(*t*) "The three enclosing-sticks, the three kindling-sticks, the poking stick called *upaveṣa*, the stirring stick, the poking stick, called *dhṛṣṭi*, (all)

[41] These are the last words of the formula when it is recited at the full-moon sacrifice. At the new-moon sacrifice, they are replaced by the following ones.

[42] According to Āp. 4.1.9, this formula should be muttered by the Sacrificer when, after fuel has been put on the Āhavanīya fire, he is standing between the Āhavanīya and the Gārhapatya.

[43] According to Āp. 4.1.10, this formula and the following one should be recited by the Sacrificer when, on the day before the day of the chief offerings, fuel is put on the Gārhapatya fire. *Cf.* Āp. 1.1.2–7.

[44] According to Āp. 4.2.1, this formula should be recited by the Sacrificer when, on the day before the day of the chief offerings, fuel is put on the Dakṣiṇāgni. The first sentence ends with *agniḥ*, and a second sentence begins with *āvāṭ*, since *āvāṭ* is accented.

[45] According to Āp. 4.2.1, this formula should be recited by the Sacrificer when, on the day before the day of the chief offerings, fuel is put on the fire of the gambling hall.

[46] According to Āp. 4.2.1, this formula should be recited by the Sacrificer when, on the same day, fuel is put on the fire of the guest room.

[47] According to Āp. 4.2.2, the Sacrificer should recite this formula when fuel has been put on all the sacred fires.

[48] According to Āp. 4.2.3, this formula should be recited by the Sacrificer and his wife when, on the day before the day of the chief offerings, they take their meal. At the full-moon sacrifice they take it before the sacrificial grass is brought for the sacrificial strew; at the new-moon sacrifice they take it before the calves are driven from the cows that will furnish the milk for the *sāṃnāyya*-offering. *Cf.* Tait.-Br. 3.2.2 and 3.2.1.

[49] According to Āp. 4.3.2, the first of these formulas should be muttered by the Sacrificer when, on the day before the day of the chief offerings, he takes the vow,—if he is a Brāhmaṇa; the second one, if he is a Kṣatriya; the third one, if he is a Vaiśya. I suppose that the fourth formula is muttered by the Sacrificer in each case.—*vratānāṃ vratapate*. In the text of the Tait.-Br., a genitive depending on an unaccented vocative is usually accented.

[50] According to Āp. 1.2.1, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings, he brings to the sacrificial ground the branch of *parṇa* tree he has cut in order to drive the calves from the cows that will furnish the milk for the *sāṃnāyya*-offering. *Cf.* Tait.-Br. 3.2.1.

[51] According to Āp. 1.6.1, this formula and the following one should be recited by the Adhvaryu when, on the day before the day of the chief offerings, he gathers sticks, and puts them on the cord he has prepared for them. *Cf.* Tait.-Br. 3.3.6.

these (sticks) that accompany the life of the sacrifice, I gather with good gathering." [52]

(*u*) "Of these plants, which were born three generations before the gods, may I successfully hit the joints, when I fetch the sacrificial strew." [53]

(*v*) "What of the waters is pure, fit for sacrifice, and divine, may that be propitious to me. When I cut you off, (O stems of Darbha grass,) may I not receive harm. May I live a hundred autumns." [54]

(*w*) "Of the ones that are unlimited in number I tie the ones that are limited in number together, for the good work (i.e., for the sacrifice). Let them (i.e., the stems of Darbha grass) rise again, and multiply." [55]

(*x*) "Thee, the sacrificial strew, which has been cut with one stroke, and which is soft as wool, thee I bring as a comfortable seat for the Fathers (i.e., the deceased ancestors). Let my dear fathers, grandfathers, and great-grandfathers sit on it with their followers." [56]

(*y*) "Let the Darbha grass, (which is) threefold, (which is) fastened to (a branch of) the *palāśa* tree, (and which is) so long, (i.e.,) measuring a span, (let the Darbha grass,) as a strainer, most purifying at the sacrifice, make, for me, the milk fit for oblation." [57]

(*z*) "Let these two, the outbreath and the inbreath, move together, making strong everywhere the limbs of the sacrifice,—(these two which appear as) the two strainers that purify the oblation."

(*aa*) "You are the two strainers which belong to Viṣṇu. Let Vāyu purify you with the mind." [58]

(*bb*) "Let this outbreath and the inbreath go into the Sacrificer. At the sacrifice, they indeed have been the two purifiers, the two strainers that purify the oblation." [59]

(*cc*) "Through thee[60] they (i.e., the gods) have acquired the earth as *vedi*; [61] through thee the all-giving sacrifice comes into existence; knowing it, thou dost accompany the undamaged sacrifice; through thee the Hotar joins the fortnights together (each one to the following one)." [62]

(*dd*) "Among the cords thou art the one that consists of thirty-three (threads). Come along with the strainer. Auspicious is this rope, the halter. Let it serve the cow." [63]

(*ee*) "In order that the sacrifice may not fall down, I place the two *ukhās* (the two vessels) (on the fire). Let them bring to Indra that which is furnished by the cows, the cooked milk and the sour milk." [64]

[52] The twenty-one sticks alluded to in the first formula (*x*) are: (1) the fifteen kindling-sticks which the Adhvaryu will put on the Āhavanīya fire when the Hotar will recite the *sāmidheni* verses; (2) the three enclosing-sticks; (3) the two sticks to be used for the two *āgharas*; (4) the one kindling-stick to be used for the after-offerings. But, according to the second formula (*t*), the Adhvaryu also gathers: one stick to be used as *upaveṣa*, one stick to be used as stirring stick, and one stick to be used as *dhṛṣṭi*. *Cf.* Tait.-Br. 3.3.7.

[53] According to Āp. 1.5.5, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings, he puts, on the joints of the sacrificial grass, the horse's rib with which he will cut it. *Cf.* Tait.-Br. 3.2.2.

[54] According to Āp. 1.5.5, this formula should be recited by the Adhvaryu when he cuts the sacrificial grass that will be used as sacrificial strew.

[55] According to Āp. 1.5.5, this formula should be recited by the Adhvaryu when he ties together the stems of Darbha grass that will be used for the sacrificial strew.

[56] According to Āp. 1.7.13, this formula should be recited by the Adhvaryu when, on the day before the chief offerings of the new-moon sacrifice, he spreads sacrificial grass on the *vedi* for the offering of rice balls to the Fathers (*piṇḍapitṛyajña*). It is probable, however, that originally this formula, or the last part of it, was recited by the Sacrificer himself.

[57] According to Āp. 1.6.10, this formula and the following one should be recited by the Sacrificer while, on the day before the day of the chief offerings, the Adhvaryu makes the *śākhāpavitra*, i.e., the strainer which is fastened to a branch of *parṇa* (= *palāśa*) tree, and will be used for the purification of the milk of the *sāṃnāyya*-offering. *Cf.* Tait.-Br. 3.2.3.3.

[58] According to Āp. 1.11.7, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings, he cuts the two blades of Darbha grass which will be used as strainers for the purification of the sprinkling waters. *Cf.* Tait.-Br. 3.2.5.1.

[59] According to Āp. 2.8.6, this formula should be recited by the Adhvaryu when, on the day of the chief offerings, he deposits the two strainers, i.e., two blades of Darbha grass, near the *prastara*, i.e., the handful of sacrificial grass that represents the Sacrificer. *Cf.* Tait.-Br. 3.3.6.7.

[60] The *veda*, which consists of a bunch of strong grass, is addressed.

[61] The *vedi* is the sacrificial bed; it is covered with sacrificial grass.

[62] According to Āp. 1.6.4, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings, he makes the bunch of strong grass called *veda*. *Cf.* Tait.-Br. 3.3.9.11.

[63] According to Āp. 1.12.8, this formula should be muttered by the Sacrificer when, on the evening of the day before the day of the chief offerings of the new-moon sacrifice, and on the morning of the day of the chief offerings, the man who is about to milk one of the cows which will furnish milk for the *sāṃnāyya*-offering, takes the halter in order to put it on the calf of that cow.—It is said that the halter consists of thirty-three threads probably because there are thirty-three gods.

[64] According to Āp. 1.12.2, this formula should be recited by the Adhvaryu when, on the day before the day of the

(*ff*) "Thou art the poking stick. Preparing the sacrificial food for Indra, they (the gods or the priests) brought thee as a (means of) service for the sacrifice. Mayest thou be gracious and helpful to us." [65]

(*gg*) "Let the vessel of the gods, which is not made of clay, be used for the long life of the sacrifice. The waters are poured through a strainer. Hold them back. May they not flow off." [66]

(*hh*) "Purified by the god Savitar by means of the rays of the good sun, do ye purify (, O Waters,) the cow, the two strainers used for the milk, the rope, and all the vessels." [67]

(*ii*) "They are coming hither (the cows), yielding sweet milk, rich in offspring, beautiful, many-colored. Let Indra make you stay here, numerous and increasing in number, O cows." [68]

(*jj*) "Ye are Pūṣan." [69]

(*kk*) "You, who are without disease, I unite with your offspring, you who are becoming numerous by the increase of wealth. Living, may I sit near to you, the living ones, who are overflowing with invigorating sap, milk, and butter." [70]

(*ll*) "Let Heaven and Earth together yield (i.e., grant us) this sacrifice. Let Dhātar with Soma, let Vāyu with Vāta, bestow wealth on the Sacrificer." [71]

(*mm*) "They milk the fountain, the pot with the four openings, the divine *iḍā*, the sweet one, that acquires heaven.—Let Indra and Agni quicken that joyous one (i.e., the flowing milk); let it put the Sacrificer into immortality." [72]

(*nn*) "Which hast thou milked? Do thou announce to Indra our oblation, (which is the oblation) that belongs to Indra." [73]

(*oo*) "Such a one, in which the milk of the gods and the men (i.e., for the gods and the men) is placed." [74]

(*pp*) "Do thou milk abundantly for Indra. Let the sacrificial food swell again for the gods. For the calves, for the men, let her (i.e., the cow) submit herself again to milking." [75]

(*qq*) "Thou art the continuity of the sacrifice. As the continuity of the sacrifice, I unite thee (with this milk)." [76]

(*rr*) "Thou art inexhaustible. For Viṣṇu, for the sacrifice, I cover thee with a vessel not void of (i.e., full of) waters that remain pure." [77]

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chief offerings of the new-moon sacrifice, he puts on the fire the two *ukhās* which are to be used for the milk of the *sāṃnāyya*-offering. One of the two *ukhās* is used for the milking in the evening, the other for the milking in the morning.

[65] According to Āp. 1.6.7, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings, having cut the branch of the *parṇa* tree, he makes of the lower part of it the poking stick.

[66] According to Āp. 1.14.3.b, this formula should be muttered by the Sacrificer when, on the day before the day of the chief offerings of the new-moon sacrifice, the Adhvaryu pours water into the iron or wooden vessel with which he will cover the milk of the *sāṃnāyya*-offering. *Cf.* Tait.-Br. 3.2.3.j.

[67] According to Āp. 1.11.10, this is the second of the two formulas which the Sacrificer should recite when, on the day before the day of the chief offerings of the new-moon sacrifice, the Adhvaryu sprinkles with water the vessels that are needed for the *sāṃnāyya*-offering. *Cf.* 3.7.4.d.

[68] According to Āp. 1.11.10.b, this formula should be muttered by the Sacrificer when, on the evening of the day before the day of the chief offerings of the new-moon sacrifice, and on the morning of the day of the chief offerings, the cows which will furnish the milk for the *sāṃnāyya*-offering come from the stable.

[69] According to Āp. 1.12.9, the formula "Thou art Pūṣan" is uttered by the man who is about to milk the cows which will furnish the milk for the *sāṃnāyya*-offering, when he puts the halter on the neck of the calf of one of the cows, and binds the hind legs of that cow with two cords. And according to Sāyaṇa's commentary on Tait.-Br. 3.7.4.15, the calf, i.e., one calf, is addressed. It is remarkable, however, that, in the text of the Tait.-Br., we have the plural *stha* instead of the singular *asi*. I suppose that with the formula "Ye are Pūṣan" the man who is about to milk the three cows addresses their three calves together.

[70] According to Āp. 1.12.14, this formula is uttered by the milker when he sits down in order to milk the cow (i.e., each of the cows which will furnish milk for the *sāṃnāyya*-offering).

[71] According to Āp. 1.12.17, this formula should be uttered by the Sacrificer while the milker is milking the cows which yield the milk for the *sāṃnāyya*-offering.

[72] According to Āp. 1.13.1, this formula should be uttered by the Sacrificer while he is listening to the noise of the milk flowing into the vessel.

[73] According to Āp. 1.13.2–3, this formula should be addressed to the milker by the Adhvaryu after the milker has milked the cow, i.e., each time after one of the three cows has been milked. *Cf.* Tait.-Br. 3.2.3.f.

[74] According to Āp. 1.13.4, this is the answer of the milker to the question of the Adhvaryu. *Cf.* Tait.-Br. 3.2.3.f.—The words "such a one" should be replaced by the name of the cow.

[75] According to Āp. 1.13.10, it is with this formula that the Adhvaryu, who has restrained his speech during the milking, releases his speech. He utters the formula three times. *Cf.* Tait.-Br. 3.2.3.g.

[76] According to Āp. 1.13.15, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings of the new-moon sacrifice, he adds the remains of the milk of the *agnihotra* to the milk of the *sāṃnāyya*-offering.

[77] According to Āp. 1.14.3, this formula should be recited by the Adhvaryu when he covers the milk of the *sāṃnāyya*-offering with an iron or wooden vessel which is used as a lid and contains water. *Cf.* Tait.-Br. 3.2.3.j.

(*ss*) "Let this bast of the *parṇa* tree, a means of purification, making the milk into soma, go back to its place of origin; for the gentle one (*saumyáḥ*) (i.e., this bast of the *parṇa* tree) has been made out of the soma (i.e., the soma plant)."[78]

(*tt*) These two, the *parṇa* (branch) and the Darbha grass, which both purify the oblation offered to the gods, do thou guard (, O Viṣṇu,) for the work of the morning. O Viṣṇu, thou protectst the oblation.[79]

(*uu*) For the benefit of me who now surround (with sacrificial grass) both fires (the Āhavanīya and the Gārhapatya), let the deities spend the night near (the sacred fires). I spend the night near the domestic animals, in order that I may become the lord of cattle.[80]

3.7.5

(*a*) dévā devéṣu párākramadhvam, práthamā dvitíyeṣu, dvítīyās tṛtíyeṣu, trírekādaśa ihá mā 'vata; idáṁ śakeyaṃ yád idáṃ karómi, ātmā karotv ātmáne; idáṃ kariṣye bheṣajám; idáṃ me viśvabheṣajā, áśvinā právatam yuvám.

(*b*) idám ahám sénāyā abhítvaryai [1] múkham ápohāmi.

(*c*) sūryajyotir víbhāhi, mahatá indriyā́ya.

(*d*) āpyāyatām ghṛtáyoniḥ, agnír havyā́ 'numanyatām, khám aṅkṣva tvácam aṅkṣva, surūpáṃ tvā vasuvídam, paśūnáṃ téjasā, agnáye júṣṭam abhíghārayāmi.

(*e*) syonáṃ te sádanaṃ karomi [2], ghṛtásya dhárayā suśévaṃ kalpayāmi.

(*f*) tásmint sīdā 'mṛte prátitiṣṭha, vrīhīṇáṃ medha sumanasyámānaḥ.

(*g*) ārdráḥ prathasnúr bhúvanasya gopáḥ, śṛtá útsnāti janitā́ matīnām.

(*h*) yás ta ātmā́ paśúṣu práviṣṭaḥ, devā́nāṃ viṣṭhā́m anu yó vitasthé, ātmanvánt soma ghṛtávān hí bhūtvā́, devā́n gaccha súvar vida yájamānāya máhyam.

(*i*) írā bhū́tiḥ pṛthivyái ráso mó 'tkramīt [3].

(*j*) dévāḥ pitaraḥ pítaro devāḥ, yò 'hám asmi (*corr.*: ásmi) sá sán yaje; yásyā́ 'smi ná tám antár emi, svā́m ma iṣṭáṁ svā́ṃ dattám svā́ṃ pūrtáṁ svā́ṁ śrāntám, svā́ṁ hutám, tásya me 'gnír upadraṣṭā́, vāyúr upaśrotā́, ādityò 'nukhyātā́, dyáuḥ pitā́ [4], pṛthiví mātā́, prajāpatir bándhuḥ, vá evá 'smi sá sán yaje.

(*k*) mā́ bhér (*corr.*: mā́ bher) mā́ sáṃvikthā mā́ [illegible], mā́ te téjo 'pakramīt, bharatám [illegible] áṅgirasīnca, avadānáni te pratyávadāsyāmi, námas te astu mā́ mā hiṁsīḥ.

(*l*) yád avadānáni te 'vadyan, vílomā́ 'kārṣam ātmánaḥ [5], ā́jyena prátyanajmi enat, tát ta āpyāyatāṃ púnaḥ.

(*m*) ájyāyo yavamātrā́t, āvyādhā́t kṛtyatām idám, mā́ rūrupāma yajñásya, śuddháṁ svíṣṭam idáṁ havíḥ.

(*n*) mánunā dṛṣṭā́m ghṛtápadīm, mitrā́vāruṇasamīritām, dakṣiṇārdhā́d ásaṃbhindan, ávadyāmy ekatómukhām [6].

(*o*) íḍe bhāgáṃ juṣasva naḥ, jínva gā́ jínvā 'rvataḥ, tásyās te bhakṣivā́ṇaḥ syāma, sarvātmānaḥ sarvágaṇāḥ.

(*p*) brádhna pínvasva, dádato me mā́ kṣāyi, kurvató me mó 'padasat, díśāṃ kḷ́ptir asi, díśo me kalpantām, kálpantāṃ me díśaḥ [7], dáivīś ca mā́nuṣīś ca, ahorātré me kalpetām, ardhamāsā́ me kalpantām, másā me kalpantām, ṛtávo me kalpantām, saṃvatsaró me kalpatām, kḷ́ptir asi kálpatām me.

(*q*) ā́śānāṃ tvā "śāpālébhyaḥ, catúrbhyo amṛ́tebhyaḥ, idáṃ bhūtásyā 'dhyakṣebhyaḥ [8], vidhéma havíṣā vayám; bhájatāṃ bhāgí bhāgám, mā́ 'bhāgó bhakta, nír abhāgáṃ bhajāmaḥ; apás pinva, óṣadhīr jinva, dvipā́t pāhi, cátuṣpād ava, divó vṛ́ṣṭim éraya, brāhmaṇā́nām idáṁ havíḥ [9], somyā́nāṁ somapīthínām, nír bhaktó 'brāhmaṇaḥ, né 'há 'brāhmaṇasyā 'sti.

(*r*) sámaṅktāṃ barhír havíṣā ghṛténa, sám ādityáir vásubhiḥ sáṃ marúdbhiḥ, sám índreṇa víśvebhir devébhir aṅktām, divyáṃ nábho gacchatu yát svā́hā.

(*s*) índrāṇi 'vā 'vidhavā́ bhūyāsam, áditir iva suputrā́, asthūrí tvā gārhapatya [10], úpa níṣade suprajāstvā́ya.

(*t*) sāṃ pátnī pátyā sukṛténa gacchatām, yaj-

[78] According to Āp. 1.13.15, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings of the new-moon sacrifice, he puts a piece of the bast of the *parṇa* tree into the sweet milk in order to obtain the sour milk for the *sāṃnāyya*-offering. *Cf.* Tait-Br. 3.2.1.a; 3.2.3.i; 3.7.4.c.

[79] According to Āp. 1.14.6, this formula should be recited by the Adhvaryu when, on the day before the day of the chief offerings of the new-moon sacrifice, he deposits in a place of which he takes good note, the strainer which is made of Darbha grass and fastened to a branch of the *parṇa* tree, and which will be used the next morning at the milking of the cows for the *sāṃnāyya*-offering.

[80] According to Āp. 4.3.6, this formula should be recited by the Sacrificer when in the evening, on the day before the day of the chief offerings, the Adhvaryu surrounds the sacred fires with sacrificial grass. *Cf.* Āp. 1.14.14.—Caland translated: "In der Nähe von mir, der ich die beiden Feuer umstreue, sollen die Götter die Nacht zubringen." But *upastṛṇaté* is a dative.—*máhyaṃ gópataye* literally means "for me the lord of cattle."

ñásya yuktáu dhuryàv abhūtām, saṃjānānáu víjahatām árātiḥ, diví jyótir ajáram árabhetām.

(*u*) dáśa te tanúvo yajña yajñíyāḥ, tāḥ prīṇātu yájamāno ghṛténa, nāriṣṭhāyoḥ praśíṣam śaṃsamānaḥ, devānāṃ dáivyé 'pi yájamāno 'mṛto 'bhūt.

(*v*) yáṃ vāṃ devā ákalpayan [11], ūrjó bhāgáṁ śatakratū, etád vāṁ téna prīṇāni, téna tṛpyatam aṁhasau (*corr.*: aṁhohau).

(*w*) ahám devāṇāṁ sukṛtām asmi loke, máme 'dám iṣṭáṃ ná míthur bhavāti, ahám nāriṣṭhāv ánuyajāmi vidvān, yád ābhyām índro ádadhād bhāgadhéyam.

(*x*) ádārasṛd bhavata (*corr.*: bhavatu) deva soma, asmín yajñé maruto mṛḍatā naḥ, má no vidad abhí bhámo áśastiḥ [12], má no vidad vṛjánā dvéṣyā yá.

(*y*) ṛṣabháṃ vājínaṃ vayám, pūrṇámāsaṃ yajāmahe, sá no dohatāṁ suvíryam, rāyás póṣaṁ sahasríṇam, prāṇáya surádhase, pūrṇámāsāya svāhā.

(*z*) amāvāsyā̀ subhágā suśévā, dhenúr iva bhūya āpyāyamānā, sá no dohatāṁ suvíryam, rāyás póṣaṁ sahasríṇam, apānáya surádhase, amāvāsyā̀yai svāhā.

(*aa*) abhístṛṇihi páridhehi védim, jāmíṃ má himṁsīr amuyā́ śáyānā, hotṛṣádanā háritāḥ suvárṇāḥ, niṣkā́ imé yájamānasya bradhné [13].

(*a*) "O gods, go to the gods; you, the (eleven) first ones, to the (eleven) second ones; you, the (eleven) second ones, to the (eleven) third ones. You, the thirty-three ones, help me here.—Here may I be able to do this that I am doing. Let the self do it for the self.—Here I shall use a means of healing. Here, O all-healing ones! O Aśvins! help me." [81]

(*b*) "Here I push away the front of the attacking army." [82]

(*c*) "O thou who hast the splendor of the sun, shine brightly for manly power (i.e., in order to give us manly power)." [83]

(*d*) "Let the one who is the place of rest of the melted butter, swell. Let Agni assent to the offerings.—Do thou anoint thy hole; do thou anoint thy skin. Thee, the beautiful one, the one who bestows wealth, I sprinkle, agreeable to Agni, with the fiery energy of the cows." [84]

(*e*) "I make a soft seat for thee. With a stream of melted butter I make it very dear (to thee)." [85]

(*f*) "Sit down on this (seat), and establish thyself in the beverage of immortality, O thou, the sap of the grains of rice,—being in good spirits." [86]

(*g*) "Moist, spreading, well cooked, the protector of the world, the progenitor of prayers, comes out." [87]

(*h*) "That soul of thine which has entered the domestic animals (i.e., the cows), (and) which has been manifoldly spread on the manifold station of the gods,—endowed with that soul, O Soma,—having become endowed with clarified butter, go to the gods, and obtain heaven for me, the Sacrificer." [88]

(*i*) "Let refreshment, prosperity, the sap of the earth, not go away." [89]

(*j*) "O gods-fathers! O fathers-gods! Being the one I am, I sacrifice. I do not pass over the

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kraft." But, since *jyotir* is not accented, we must consider it as the second element of the Bahuvrīhi compound *sūryajyotis*. Sāyaṇa explains *sūryajyotiḥ* by *sūryasamānadīptiḥ san*. I believe, however, that it is not a nominative but a vocative.

[81] According to Āp. 4.4.1, these formulas should be recited by the Sacrificer just before he chooses the Brahmán-priest; and according to Kātyāyana 2.1.18, the choosing of the Brahmán-priest takes place, on the day of the chief offerings, immediately after the morning *agnihotra*.

[82] According to Āp. 1.24.6, this formula should be uttered by the Adhvaryu when, on the day of the chief offerings, he pushes away, by means of the *veda*, the burning embers which he has placed on the potsherds in order to heat them for the baking of the sacrificial cake. *Cf.* Āp. 1.23.6.

[83] According to Āp. 2.10.4, the Adhvaryu should recite this formula over the sacrificial cake assigned to Agni, just before sprinkling it with melted butter.—Caland translated: "O Sonne, verbreite dein Licht zu grosser Lebens-

[84] According to Āp. 2.10.4, this formula should be recited by the Adhvaryu while he sprinkles the sacrificial cake with melted butter.

[85] According to Āp. 2.10.6, this formula should be recited by the Adhvaryu when he spreads out clarified butter in the pan where he will put the sacrificial cake assigned to Agni.

[86] According to Āp. 2.11.1, this formula should be recited by the Adhvaryu when he puts the sacrificial cake in the pan.—Caland's translation "Sitze und become festen Fuss in diesem Ambrosia, dem Opfer von Reis" is unacceptable, for *medha* certainly is a vocative.—*vrīhīṇāṃ medha*. In the text of the Tait.-Br. a genitive depending on an unaccented vocative is usually accented. *Cf.* Tait. Br. 3.7.4.9: *vratānāṃ vratapate*.

[87] According to Āp. 2.10.6, this formula should be uttered by the Adhvaryu when he removes the sacrificial cake from the fire.—The meaning of *prathasnur*, which is a hapax legomenon, is uncertain. The word is not accented in the text. We probably should read *prathasnúr*.

[88] According to Āp. 2.10.5, the Adhvaryu, speaking for the Sacrificer, should recite this formula when, at the new-moon sacrifice, he adds melted butter to the milk of the *sāṃnāyya*-offering, after the milk has been cooked.

[89] According to Āp. 2.11.3, the Adhvaryu, with this formula, should spread out clarified butter, by means of the *sruva*, over each of the potsherds, which have been arranged for the sacrificial cake.

one to whom I belong (i.e., my father).—I have offered that which is mine; I have given (to the gods) that which is mine; I have bestowed (on the priests) that which is mine; I have made the penance which is mine; I have poured as an oblation (into the fire) that which is mine.—Of this (sacrifice) of mine, Agni is the one (i.e., the witness) who sees it; Vāyu, the one (i.e., the witness) who hears it; Āditya, the one (i.e., the witness) who proclaims it.—The father is the Sky; the mother is the Earth; the kinsman is Prajāpati.—Being indeed the one I am, I sacrifice." [90]

(*k*) "Do not be afraid, do not be terrified. I will not hurt thee. May thy fiery energy not go away. Do thou raise Bharata (i.e., Agni); do thou sprinkle him (with melted butter). Portions of thee I shall cut out again. Homage to thee! Do not hurt me." [91]

(*l*) "If, while cutting the portions of thee, I have done anything that is, for thyself, contrary to the proper course, I besmear that with clarified butter. Let that (part) of thee swell again." [92]

(*m*) "A piece not greater than a barley corn should be cut off here from that spot that has been pierced. (By doing so) may we not break off somewhat of the sacrifice. This oblation (will be) pure (i.e., complete) and well offered." [93]

(*n*) "The one who was seen by Manu, the one whose footprints are full of butter, the one who was set in motion by Mitra and Varuṇa, the one whose face is (always) turned in only one direction, (the Iḍā,) I cut off from the southern half (of the cake) without bringing (that portion) into contact (with the other portions)." [94]

(*o*) "O Iḍā, do thou enjoy our share; do thou refresh the cattle, do thou refresh the horses. We who partake of thee, may we be completely wholesome, with all our people." [95]

(*p*) "O reddish one, do thou swell. As I am presenting a gift (to the gods), let it not be diminished. As I am performing a sacrifice, let it not fail.—Thou art the regular order of the quarters. Let the quarters be in regular order for me. In regular order let the quarters be for me, the divine ones and the human ones. Let day and night be in regular order for me. Let the fortnights be in regular order for me. Let the months be in regular order for me. Let the seasons be in regular order for me. Let the year be in regular order for me.—Thou art the regular order. Let it be (i.e., let everything be) in regular order for me." [96]

(*q*) "To the protectors of the quarters, to the four immortal ones, (we would offer) thee. Here, to the (four) supervisors of the world, we would offer (thee as) an oblation.—Let the one who is entitled to receive a share, receive his share; let not the one who is not entitled to receive a share, receive one. We exclude from the sharing the one who is not entitled to receive a share.—Do thou cause the waters to swell, do thou quicken the plants, protect the two-footed ones, help the

[90] According to Āp. 4.9.6, these formulas should be muttered by the Sacrificer while the first *pravara* is performed by the Hotar, and also while the second *pravara* is performed by the Adhvaryu. The *pravara* is a rite that chiefly consists of the enumeration of the Sacrificer's ancestors. It is called *pravara* because it is connected with the "choosing" of the Hotar. At the full-moon and new-moon sacrifices, there are two *pravaras*. The first one takes place after the first *āghāra* (the first libation of butter); the second one takes place after the second *āghāra*.

[91] According to Āp. 2.18.9, these formulas should be recited by the Adhvaryu when he cuts out four or five portions from the sacrificial cake assigned to Agni.—The meaning of *pratyavadāsyāmi* is uncertain. According to the dictionary of Monier-Williams, *pratyavadyati* means "to divide again," and Caland translated *avadānāni te pratyavadāsyāmi* "deine abgeschnittenen Teile werde ich wieder abschneiden." But Sāyaṇa explains: *tvadīyāny avadānāni pratyavadāsyāmi pratyekam avadānaṃ kariṣyāmi*. If we accept this interpretation, we may translate: "I shall cut out the portions of thee one by one."

[92] According to Āp. 2.19.6, this formula should be recited by the Adhvaryu when he pours out clarified butter over the sacrificial cake from which he has cut out the four or five portions.

[93] According to Āp. 3.1.2, this formula should be uttered by the Adhvaryu when, after the oblation to Agni Sviṣṭakṛt, he cuts off from the sacrificial cake assigned to Agni the *prāśitra*, i.e., the little piece of cake that is to be eaten by the Brahmán before the *iḍā* ceremony. The meaning of *mā rūrupāma yajñāsya* is doubtful. Caland translated: "wir wollen das Opfer in Ordnung bringen." I do not think that this translation is acceptable. Sāyaṇa explains: *mā rūrupāma ropaṇaṃ vimohanam . . . na karavāma*. But I do not think that the causative of *rup* means "to cause confusion." I think that here the causative of *rup* means "to break off," and that *yajñāsya* is a partitive genitive. *Cf. ava-dā* with the genitive "to cut off some of."

[94] According to Āp. 3.1.7, this formula should be uttered by the Adhvaryu when he cuts off the first portion of the *iḍā* from the southern half of the sacrificial cake assigned to Agni.

[95] According to Āp. 3.2.11, this formula should be muttered by the Hotar, the Adhvaryu, the Brahmán, the Āgnīdhra, and the Sacrificer, when they are about to eat the *iḍā*.

[96] According to Āp. 4.10.9, these formulas should be uttered by the Sacrificer when he touches the sacrificial cake assigned to Agni, after it has been placed on the sacrificial strew.

four-footed ones;[97] procure (us) rain from the sky.—This is the oblation for the Brāhmaṇas who offer the soma, who drink the soma. He who is not a Brāhmaṇa is excluded from the sharing. For him who is not a Brāhmaṇa there is nothing here."[98]

(*r*) "Let the sacrificial strew anoint itself with the sacrificial substance, with the clarified butter. Let it anoint itself with the Ādityas, with the Vasus, with the Maruts, with Indra, with the Viśve Devāḥ.—Let it go to that (light) which is the sky divine. Svāhā!"[99]

(*s*) "Like Indrāṇī, may I be not a widow; like Aditi, may I have excellent sons. Not single-horsed, I sit down near thee, O Gārhapatya, in order that I may have many children."[100]

(*t*) "With the husband, let the wife partake of the good deed. Having been yoked, they (i.e., husband and wife) have become fit for the drawing of the sacrifice. Being of the same mind, let them both get rid of their enemies. May they attain undecaying light in heaven."[101]

(*u*) "Ten are thy forms worthy of worship, O Sacrifice. Let the Sacrificer rejoice them with clarified butter. Praising the order of the two Nāriṣṭhas (the two manliest ones), the Sacrificer has become immortal in the divine (abode) of the gods."[102]

(*v*) "With that share of invigorating sap which the gods prepared for you both, O powerful ones, I will now rejoice you. Let you both be fully satisfied with it, O destroyers of distress."[103]

(*w*) "I am in the world of the beneficent gods. The oblation of mine shall not fail. Knowing, I offer to the Nāriṣṭhas the share that Indra established for them."

(*x*) "Let him (i.e., the Sacrificer) be not one falling into the cleft (i.e., into misfortune),[104] O god Soma. At this sacrifice, O Maruts, be gracious to us. Let not wrath, nor curse, find us. Let not the insidiousness that is hateful fall upon us."

(*y*) "To the strong bull, to the Full-Moon, we sacrifice. Let him give us manly power and thousandfold increase of wealth. To the bountiful Outbreath, to the Full-Moon, svāhā!"[105]

(*z*) "The New-Moon, prosperous and auspicious, (is) like a milch cow, swelling more and more. Let her give us manly power and thousandfold increase of wealth. To the bountiful Inbreath, to the New-Moon, svāhā!"[106]

(*aa*) "Do thou spread (blades of sacrificial grass) over the *vedi*, and surround it (with them).[107] Lying down (on the *vedi*) in such a way, do not harm a relative (i.e., the *vedi*).—Yellow, of beautiful color, these (blades of sacrificial grass), which are the seat of the Hotar, (will be) the *niṣkas* (the golden ornaments) of the Sacrificer in the reddish-yellow region (i.e., in the world of the sun, or the heavenly world)."[108]

[97] *dvipād* and *catuṣpād* are acc. sing. neuter used collectively.

[98] According to Āp. 4.11.1, these formulas should be uttered by the Sacrificer when he separates, according to the four quarters, the four parts of the sacrificial cake assigned to Agni.

[99] According to Āp. 4.12.3, this formula should be recited by the Sacrificer when the *prastara*, which is a handful of sacrificial grass, and represents the Sacrificer, is anointed by the Adhvaryu in the three sacrificial spoons. *Cf.* Tait.-Br. 3.3.9.b.—Caland translated: "zum Himmelsgewölbe gehe sie, die (mit) Svāhā (ruf) (dargebracht)." But it seems difficult to admit that *hutam* or *samārpitam* should be understood. On the other hand, it is remarkable that, according to Āp. 3.6.7, when the Adhvaryu throws the *prastara* into the Āhavanīya fire, he does not utter the exclamation *svāhā*.

[100] According to Āp. 2.5.9, this formula should be muttered by the wife of the Sacrificer when she sits down near the Gārhapatya fire. *Cf.* Tait.-Br. 3.3.3.a.

[101] According to Āp. 3.9.10, this formula should be uttered by the Adhvaryu when, after the *patnīsaṃyājas*, he offers the *saṃpatnīya*-oblation while the Sacrificer's wife is touching him.

[102] According to Āp. 2.20.6, this formula and the three following ones should be recited by the Adhvaryu when, after the *pārvaṇa*-oblation (i.e., the oblation relating to the day of the change of the moon), but before the oblation to Agni Sviṣṭakṛt, he offers the oblations to the two Nāriṣṭhas.—I think that *nāriṣṭha* is the superlative of *nāra* "manly," and that the two deities called Nāriṣṭhas are the *prāṇa* and the *apāna*. Sāyaṇa explains: *nāriṣṭhāv agnivāyū jātharāgniḥ prāṇavāyuś cā 'tiśayena nareṇa saṃbaddhau*.

[103] As Caland suggested, we should probably read *aṁhohau*.

[104] It is probable that, instead of *bhavata*, we should read *bhavatu* (*cf.* AV. 1.20.1). Caland translated: "Wir sollen nicht in eine Spalte (d.h. ins Unglück) geraten." I think, however, that the subject of *bhavatu* is *yājamānaḥ* understood.

[105] According to Āp. 2.20.5, this formula should be recited by the Adhvaryu when, at the full-moon sacrifice, after the chief offerings, he offers the *pārvaṇahoma*, i.e., the oblation relating to the day of the change of the moon.

[106] According to Āp. 2.20.5, this formula should be recited by the Adhvaryu when, at the new-moon sacrifice, after the chief offerings, he offers the *pārvaṇahoma*.

[107] According to Sāyaṇa, these words are addressed to the sacrificial grass.

[108] According to Āp. 3.13.5, this formula should be recited by the Adhvaryu when, after the oblation called *samiṣṭayajus* has been offered to Vāta (*cf.* Tait.-Br. 3.3.9.j), he spreads the sacrificial grass of the seat of the Hotar over the *vedi*.—The meaning of *amuyā śāyānā* is uncertain. Caland translated: "indem du zwecklos liegen bleibest."

3.7.6

(*a*) páristṛṇīta páridhattā 'gním; párihito 'gnír yájamānanaṃ bhunaktu; apáṁ rása óṣadhīnāṁ suvárṇaḥ; niṣkā́ imé yájamānasya santu kāmadúghāḥ, amútrā 'múṣmiṁ loké.

(*b*) bhū́pate bhúvanapate, maható bhūtásya pate, brahmáṇaṃ tvā vṛṇīmahe.

(*c*) ahám bhū́patir ahám bhúvanapatiḥ, ahám maható bhūtásya pátiḥ [1], devéna savitrā́ prásūta ártvijyaṃ karisyāmi, déva savitar etáṃ tvā vṛṇate, bṛ́haspátiṃ dáivyaṃ brahmáṇam; tád ahám mánase prábravīmi, máno gāyatriyái, gāyatrī́ triṣṭúbhe, triṣṭúb jágatyai, jágaty anuṣṭúbhe, anuṣṭúk paṅktyái, paṅktíḥ prajā́pataye [2], prajā́patir víśvebhyo devébhyaḥ, víśve devā́ bṛ́haspátaye, bṛ́haspátir bráhmaṇe; bráhma bhū́r bhúvaḥ súvaḥ; bṛ́haspátir devā́nāṃ brahmā́, ahám manuṣyā́ṇām; bṛ́haspate yajñáṃ gopāya.

(*d*) idáṃ tásmai harmyáṃ karomi, yó vo devā́ś cárati brahmacáryam; medhāví dikṣú mánasā tapasví [3], antár dūtáś carati mánuṣīṣu.

(*e*) cátuḥśikhaṇḍā yuvatíḥ supéśāḥ, ghṛtápratikā bhúvanasya mádhye; marmṛjyámānā mahaté sáubhagāya, máhyaṃ dhukṣva yájamānāya kā́mān.

(*f*) bhū́mir bhūtvā́ mahimā́naṃ puposa, táto devī́ vardhayate páyāṁsi; yajñíyā yajñáṃ ví ca yánti śáṃ ca, óṣadhīr ā́pa ihá śákvarīś ca.

(*g*) yó mā hṛdā́ mánasā yáś ca vācā́ [4], yó bráhmaṇā kármaṇā dvéṣṭi devā́ḥ, yáḥ śruténa hṛ́dayene 'ṣṇatā́ ca, tásye 'ndra vájreṇa śíraś chinadmi.

(*h*) ū́rṇāmṛdu práthamānaṁ syonám, devébhyo júṣṭaṁ sádanāya barhíḥ; suvargé loké yájamānaṁ hí dhehí, máṁ nákasya pṛṣṭhé paramé vyòman.

(*i*) cátuḥśikhaṇḍā yuvatíḥ supéśāḥ, ghṛtápratikā vayúnāni vaste; sā́ stīryámāṇā mahaté sáubhagāya [5], sā́ me dhukṣva yájamānāya kā́mān; śivā́ ca me śagmā́ cai 'dhi; syonā́ ca me suṣádā cai 'dhi; ū́rjasvatī ca me páyasvatī cai 'dhi; íṣam ū́rjaṃ me pinvasva; bráhma téjo me pinvasva, kṣatrám ójo me pinvasva, víśaṃ pū́ṣṭiṃ me pinvasva, áyur annádyaṃ me pinvasva, prajā́ṃ paśū́n me pinvasva [6].

(*j*) asmín yajñá úpa bhūya ín nú me, ávikṣobhāya paridhín dadhāmi; dhartā́ dharúṇo dhárīyān, agnír dvéṣāṁsi nír itó nudātai.

(*k*) vícchinadmi vídhṛtībhyāṁ sapátnān, jātā́n bhrā́tṛvyān yé ca janiṣyámāṇāḥ; viśó yantrā́bhyāṃ vídhamāmy enān, ahā́ṁ svā́nām uttamò 'sāni devā́ḥ; viśó yantré nudámāne árātim, víśvaṃ pāpmā́naṃ ámatiṃ durmarāyúṃ [7], sídanti devī́ sukṛtásya loké, dhṛ́tī stho vídhṛtī svádhṛtī; prāṇā́n máyi dhārayatam, prajā́ṃ máyi dhārayatam, paśū́n máyi dhārayatam.

(*l*) ayáṃ prastará ubháyasya dhartā́, dhartā́ prayājā́nām utā́ 'nūyājā́nām; sá dādhāra samídho viśvárūpāḥ; tásmint sruco ádhy āsādayāmi.

(*m*) āroha pathó juhu devayā́nān [8], yátrā́ ṛṣayaḥ prathamajā́ yé purāṇā́ḥ; híraṇyapakṣā 'jirā́ sáṃbhṛtāṅgā, váhāsi mā sukṛ́tām yátra lokā́ḥ.

(*n*) ávā 'háṃ bādha upabhṛ́tā sapátnān, jātā́n bhrā́tṛvyān yé ca janiṣyámāṇāḥ; dóhaṃ yajñáṁ sudúghām iva dhenúm; ahám úttaro bhūyāsam, ádhare mát sapátnāḥ.

(*o*) yó mā vācā́ mánasā durmarāyúḥ, hṛdā́ 'rātīyā́d abhidā́sad agne [9], idám asya cittám ádharaṃ dhruvā́yāḥ; ahám úttaro bhūyāsam, ádhare mat sapátnāḥ.

(*p*) ṛṣabhó 'si śākvaráḥ, ghṛtā́cīnāṁ sūnúḥ; priyéṇa nā́mnā priyé sádasi sīda.

(*q*) syonó me sīda suṣádaḥ pṛthivyā́m; páthayi prajā́yā paśúbhiḥ survargé loké, diví sīda pṛthivyā́m antárikṣe; ahám úttaro bhūyāsam [10], ádhare mát sapátnāḥ.

(*r*) iyáṁ sthālī́ ghṛtásya pūrṇā́, ácchinnapayāḥ śatádhāra útsaḥ, māruténa śármaṇā dáivyena.

(*s*) yajñò 'si sarvátaḥ śritáḥ; sarváto mā́ṃ bhūtā́ṃ bhaviṣyā́c chrayatām; śatā́ṃ me santv āśíṣaḥ, sahásraṃ me santu sūnṛ́tāḥ, írāvatīḥ paśumátīḥ; prajā́patir asi sarvátaḥ śritáḥ [11]; sarváto mā́ṃ bhūtā́ṃ bhaviṣyā́c chrayatām, śatā́ṃ me santv āśíṣaḥ, sahásraṃ me santu sūnṛ́tāḥ írāvatīḥ paśumátīḥ.

(*t*) idám indriyám amṛ́taṃ vīryàm; anéné 'ndrāya paśávo 'cikitsan; téna devā́ avató 'pa mā́m, ihé 'ṣam (*corr.*: mā́m ihá; íṣam) ū́rjaṃ yáśaḥ sáha ójaḥ saneyam; śṛtā́ṃ máyi śrayatām.

(*u*) yát pṛthivī́m ácarat tát práviṣṭam [12], yéná 'siñcad bálam índre prajā́patiḥ, idáṃ tác chukrā́ṃ mádhu vā́jinīvat, yéno 'párisṭād ádhinon mahendrám; dádhi mā́ṃ dhinotu.

(*v*) ayáṃ vedáḥ pṛthivī́m ánvavindat, gúhā satī́ṃ gáhane gáhvareṣu; sá vindatu yájamānāya lokám; ácchidraṃ yajñáṃ bhūrikarmā́ karotu.

(*w*) ayáṃ yajñáḥ sámasadad dhavíṣmān, ṛcā́ sā́mnā yájuṣā devátābhiḥ [13]; téna lokā́nt sū́ryavato jayema; índrasya sakhyám amṛtatvám aśyām.

The meaning of *bradhné* is also uncertain. Caland translated: "im höchsten (Raum)." Sāyaṇa explains: *bradhne karmaphalabhūta ādityaloke*. I think that *jāmim* designates the *vedi* considered as the relative of the sacrificial grass.

(*x*) yó naḥ kánīya ihá kāmáyātai, asmín yajñé yájamānāya máhyam, ápa tám indrāgnī bhúvanān nudetām; ahám prajām vīrávatīm videya.

(*y*) ágne vājajit, vājaṃ tvā sariṣyántam, vājaṃ jeṣyántam, vājínaṃ vājajítam [14], vājajityā́yai sáṃmārjmi, agním annādám annādyāya.

(*z*) úpahūto dyáuḥ pitā́, úpa mā́m dyáuḥ pitā́ hvayatām; agnír ágnīdhrāt, áyuṣe várcase jīvā́tvái púṇyāya; úpahūtā pṛthiví mātā́, úpa mā́m mātā́ pṛthiví hvayatām; agnír ágnīdhrāt [15], áyuṣe várcase, jīvā́tvái púṇyāya.

(*aa*) máno jyótir juṣatām ājyam; vícchinnaṃ yajñáṃ sám imáṃ dadhātu; bṛ́haspátis tanutām imáṃ naḥ; víśve devā́ ihá mādayantām.

(*bb*) yáṃ te agna āvṛ́cāmi, aháṃ vā kṣipitā́ cáran, prajā́m ca tásya mū́laṃ ca, nī́cair devā nívṛścata [16]; ágne yó no 'bhidā́sati, samānó yáś ca níṣṭyaḥ, idhmásye 'va prakṣā́yataḥ, mā́ tásyó 'cchetsi kíṃ caná; yó mā́m dvéṣṭi jātavedaḥ, yáṃ cā 'hā́m dvéṣmi yáś ca mā́m, sárvāṁs tā́n agne sáṃdaha, yā́ṁś cā 'hā́m dvéṣmi yé ca mā́m.

(*cc*) ágne vājajit, vājaṃ tvā sasṛvā́ṁsam [17], vā́jaṃ jigivā́ṁsam, vājínaṃ vājajítam, vājajityā́yai sáṃmārjmi, agním annādám annādyāya.

(*dd*) védir barhíḥ śritáṁ havíḥ, idhmáḥ paridhā́yaḥ srúcaḥ, ā́jyaṃ yajñá ṛ́co yájuḥ, yājyàś ca vaṣaṭkārā́ḥ, sáṃ me sáṃnatayo namantām, idhmasaṃnáhane huté [18].

(*ee*) diváḥ khíló 'vatataḥ, pṛthivyā́ ádhi útthitaḥ; téna sahásrakāṇḍena, dviṣántaṁ śocayāmasi; dviṣán me bahú śocatu; óṣadhe mó aháṁ śucam.

(*ff*) yájña námas te yajña, námo námaś ca te yajña; śivéna me sáṃtiṣṭhasva; syonéna me sáṃtiṣṭhasva [19]; subhūténa me sáṃtiṣṭhasva; brahmavarcaséna me sáṃtiṣṭhasva; yajñásyā́ rdhim ánu sáṃtiṣṭhasva; úpa te yajña námaḥ, úpa te námaḥ, úpa te námaḥ.

(*gg*) tríṣ phalī́-kriyámāṇānām, yó nyaṅgó avaśíṣyate, rákṣasāṃ bhāgadhéyam, ā́pas tát právahatād itáḥ [20].

(*hh*) ulū́khale músale yác ca śū́rpe, āśiślé́ṣa dṛṣádi yát kapā́le, avaprúṣo viprúṣaḥ sáṃyajāmi; víśve devā́ havír idáṃ juṣantām; yajñé yā́ viprúṣaḥ sánti bahvíḥ, agnáu tā́ḥ sárvāḥ sviṣṭā́ḥ súhutā́ juhomi.

(*ii*) udyánn adyá mitramahaḥ, sapátnān me anīnaśaḥ; dívai 'nān vidyútā́ jahi; nimrócann ádharān kṛdhi [21].

(*jj*) udyánn adyá ví no bhaja, pitā́ pitré́bhyo yáthā; dīrghāyutvásya he 'śiṣe, tásya no dehi sū́rya.

(*kk*) udyánn adyá mitramahaḥ, āróhann úttarāṃ dívam, hṛdrogáṃ máma sū́rya, harimā́ṇaṃ ca nāśaya.

(*ll*) śúkeṣu me harimā́ṇam, ropaṇā́kāsu dadhmasi [22], átho hāridravéṣu me, harimā́ṇaṃ nídadhmasi.

(*mm*) údagād ayám ādityáḥ, víśvena sáhasā sahá; dviṣántaṃ máma randháyan, mó aháṃ dviṣató radham.

(*nn*) yó naḥ śápād áśapataḥ, yáś ca naḥ śápataḥ śápāt, uṣā́ś ca tásmai nimrúk ca, sárvaṃ pāpáṁ sámūhatām.

(*oo*) yó naḥ supátno yó ráṇaḥ, márto 'bhidā́sati devāḥ, idhmásye 'va prakṣā́yataḥ, mā́ tásyó 'cchetsi kíṃ cana.

(*pp*) ávasṛṣṭaḥ párāpata, śaró bráhmasaṁśitaḥ; gácchā 'mítrān práviśa; mái 'ṣāṃ káṃ canó 'cchiṣaḥ [23].

(*a*) "Do ye spread (blades of Darbha grass) around the fire, and surround it (with them),[109] Let the fire, having been surrounded, profit the Sacrificer. The sap of the waters and of the herbs is of beautiful color. Let these (blades of Darbha grass) be the *niṣkas* (the golden ornaments) of the Sacrificer, yielding, like milk, the objects of his desire, there, in yonder (heavenly) world." [110]

(*b*) "O lord of the earth, O lord of the world, O lord of the great creation! thee we choose as our Brahmán." [111]

(*c*) "I am the lord of the earth; I am the lord of the world; I am the lord of the great creation. Impelled by the god Savitar, I shall accomplish the duties of the priest-function.—O god Savitar, thee they choose here as Bṛhaspati, as the divine Brahmán. This I announce to the Mind; the Mind announces it to the Gāyatrī; the Gāyatrī to the Triṣṭubh; the Triṣṭubh to the Jagatī; the Jagatī to the Anuṣṭubh; the Anuṣṭubh to the Paṅkti; the Paṅkti to Prajāpati; Prajāpati to

[109] According to Sāyaṇa, these words are addressed to the blades of Darbha grass; but they may be an order given by the Adhvaryu to his assistants. Āpastamba says that this *mantra* is a *praiṣa*.

[110] According to Āp. 1.14.12, this formula should be recited by the Adhvaryu when, at the new-moon sacrifice, on the day before the day of the chief offerings, after the milking of the cow that yields the milk for the *sāṃnāyya*-offering, he spreads sacrificial grass around the three sacred fires.

[111] According to Āp. 3.18.2, it is with this formula that the Sacrificer formally chooses the priest called Brahmán. According to Kātyāyana 2.1.18, the choosing of the Brahmán takes place immediately after the morning *agnihotra* has been offered, on the day of the chief oblations.

the Viśve Devāḥ; the Viśve Devāḥ to Bṛhaspati; Bṛhaspati to the Bráhman (the Holy Power of the Sacred Word).—(The three exclamations:) Bhūḥ, Bhuvaḥ, Suvaḥ are (i.e., represent) the Bráhman.—Bṛhaspati is the Brahmán (i.e., the priest called Brahmán) of the gods. I am (the Brahmán) of men. O Bṛhaspati, protect the sacrifice." [112]

(*d*) "Here I make a dwelling place for that one who for you, O gods, practices chastity. The wise one, the one who, in his heart, practices austerities, wanders as a messenger within the regions of men." [113]

(*e*) "Four-tufted, well adorned, the young girl, with her face brilliant with clarified butter, (is) in the middle of the world. So, being adorned for great happiness, (O vedi,) do thou give to me, the Sacrificer, the objects of my desire." [114]

(*f*) "Having become the earth, she (i.e., the *vedi* considered as a goddess) has increased her greatness; consequently the goddess causes the saps to grow. Fit for the sacrifice, they diffusively pervade the sacrifice and (increase) prosperity; and the powerful waters here (diffusively pervade) the plants." [115]

(*g*) "Of that one who, with his heart, with his mind, and with his speech, who, with the power of the sacred word of his payer, and with his deeds, is hostile to me, O gods!—of that one who is hostile to me with his knowledge of sacred lore, and with his envious heart,—of that one, O Indra, I cut off the head with thy thunderbolt." [116]

(*h*) "Soft as wool, the sacrificial strew, spreading itself, (is) a comfortable seat, agreeable to the gods to sit on. Do thou (, O sacrificial strew,) place me, the Sacrificer, in the heavenly world, at the summit of the firmament, in the highest sky." [117]

(*i*) "Four-tufted, well adorned, the young girl (i.e., the *vedi*), with her face brilliant with clarified butter, clothes herself with the established rules (i.e., prepares herself according to the established rules).[118] So, being spread over (with sacrificial grass) for great happiness, (O *vedi*,) do thou give to me, the Sacrificer, the objects of my desire. For me, be gracious and helpful; for me, be soft and comfortable to sit on; for me, be rich in strength and rich in sap. For me, do thou cause sap and strength to prosper. For me, do thou cause the order of the Brāhmaṇas, and fiery energy, to prosper; for me, do thou cause the order of the Kṣatriyas, and force, to prosper; for me, do thou cause the order of the Vaiśyas, and cattle-breeding, to prosper. For me, do thou cause vital power and food to prosper. For me, do thou cause offspring and cattle to prosper." [119]

(*j*) "At this my sacrifice, now once more, in order that it may not be disturbed, I lay the enclosing-sticks. Let the supporter, the one who holds fast, the one who supports better (than anyone else),—let Agni drive away the enemies from here." [120]

[112] According to Āp. 3.18.3–4, these formulas should be muttered by the Brahmán immediately after he has been chosen by the Sacrificer.

[113] According to Āp. 4.5.3 (*cf.* Āp. 2.1.8), this formula should be uttered by the Sacrificer when, at the time of the preparation of the *vedi*, the Āgnīdhra, with both hands, presses, on the *utkara*, the loose earth that he has received from the Adhvaryu.—The exact meaning of the formula is not clear. I suppose that the words "that one who practices chastity, . . . the wise one," etc. designate the Āgnīdhra, whose seat is situated near the *utkara*.

[114] According to Āp. 4.5.1, this formula should be recited by the Sacrificer when, before the *stambayajus* ceremony (*cf.* Tait.-Br. 3.2.9), the Adhvaryu touches three times, with the *veda*, the place where the *vedi* is to be prepared (*cf.* Āp. 2.1.3).

[115] According to Āp. 4.5.5, this formula should be recited by the Sacrificer while the *vedi* is being prepared.—Caland translated *yajñiyā yajñām vi ca yanti* "die zum Opfer taufglichen Männer lesen das Opfer aus," as if we should read *vicayanti*. But the reading of the Tait.-Br. is *vi ca yanti*, and that is also the reading of Sāyaṇa's commentary.—I think that *yajñiyā* is not a nom. pl. masc. (*yajñiyāḥ*), but a nom. pl. neuter, and that *vi yanti* means "they diffusively pervade." The verb is accented because it is the verb of the first of two antithetical clauses, the antithesis being indicated by *ca . . . ca* (*cf.* Macdonell, *A Vedic Grammar for Students*, 468); and the verb of the second clause is *vi yanti* understood (*cf. ibid.*, 229). I think that, in the second clause, *āpaḥ* (nom. pl.) is the subject, and that *oṣadhīḥ* (acc. pl.) is the object of *vi yanti* understood.

[116] According to Āp. 4.5.2, this formula should be recited by the Sacrificer when, at the time of the preparation of the *vedi*, the Adhvaryu takes up the (first) grass-bush called *stambayajus* (*cf.* Tait.-Br. 3.2.9.d).—*iṇatā*: This is the instr. sing. of the pres. part. of *iṇ* "to desire" conjugated according to the *nā*- class. *Cf.* RV. 1.61.13 and 10.61.5.—Sāyaṇa explains: *hṛdayena 'ṇatai 'ṇaṇaśilene 'daṃ dhanādikaṃ mamai 'va bhūyād ity evaṃrūpena hṛdayena.*

[117] According to Āp. 4.5.5, this formula should be recited by the Sacrificer over the sacrificial grass when the Āgnīdhra (or the Adhvaryu) puts it down, along with fuel, north of the Āhavanīya fire. *Cf.* Āp. 2.3.17 and Tait.-Br. 3.2.10.e.

[118] *Cf.* Pischel und Geldner, *Vedische Studien*, 1,305.

[119] According to Āp. 4.6.2, these formulas should be recited over the *vedi* by the Sacrificer when it is spread over with sacrificial grass. *Cf.* Tait.-Br. 3.3.6.g.

[120] According to Āp. 4.6.3, this formula should be recited by the Sacrificer when the three enclosing-sticks have been put around the Āhavanīya fire. *Cf.* Tait.-Br. 3.3.7.a and Āp. 2.9.5.

(*k*) "By means of the two *vidhṛtis*[121] I destroy my rivals, the rivals who have already been born and the ones who will be born. By means of the two supports of the order of the Vaiśyas I disperse those (rivals); and I shall be at the head of my people, O gods!—Being the two supports of the order of the Vaiśyas, driving away hostility, every evil, and want, which is difficult to be destroyed,—being two goddesses sitting in the world of good action, (O *vidhṛtis*,) you are supports (*dhṛtī*), separations (*vidhṛtī*), and self-supports (*svadhṛtī*). Do support the vital breaths in me; do support offspring around me; do support cattle around me." [122]

(*l*) "This *prastara* is the supporter of both, the supporter of the fore-offerings and of the after-offerings. It supports the multiform kindling-sticks. On it I lay the sacrificial spoons." [123]

(*m*) "Ascend, O *juhū*, the ways that lead to the gods, (the ways) whereon the firstborn ancient Ṛṣis (have gone).—Golden-winged, swift, and having a well-fed body, do thou bring me there where the wide spaces that belong to the pious men are." [124]

(*n*) "With the *upabhṛt* I keep off my rivals, the rivals who have already been born and the ones who will be born. I will milk the sacrifice like a milch cow that yields much milk. May I be higher (than my rivals), and may my rivals be lower than myself." [125]

(*o*) "Of that one who,—being difficult to be put to death,—with his speech, with his mind, with his heart, will be hostile to me, and will try to harm me, O Agni,—of that one the (bad) intent is here, underneath the *dhruvā*. May I be higher (than my rivals), and may my rivals be lower than myself." [126]

(*p*) "Thou art the mighty bull, the son of the ones who abound in butter. With thy favorite name sit on thy favorite seat."

(*q*) "Kind to me, do thou sit down, comfortably seated, on the earth. Let me spread with offspring and cattle in the heavenly world. Do thou sit down in heaven, on earth, and in the atmosphere. May I be higher (than my rivals), and may my rivals be lower than myself." [128]

(*r*) "This *sthālī* (this earthen vessel), full of clarified butter, is a spring with an uninterrupted (flowing of) fluid, and with a hundred streams, thanks to the protection of the Maruts." [129]

(*s*) "Thou art the sacrifice, supported from all sides. Let the past and the future support me from all sides. Let me have a hundred wishes, and let me have a thousand joys in food and in cattle.—Thou art Prajāpati, supported from all sides. Let the past and the future support me from all sides. Let me have a hundred wishes, and let me have a thousand joys in food and in cattle." [130]

(*t*) "This is manly strength, (it is) the beverage of immortality, (it is) manly power. With this, the cows attended Indra. With this, O gods, do you help me here. May I acquire invigorating sap and strength, and glory, and power, and vigor. Let the cooked (milk) abide in me." [131]

[121] The *vidhṛtis* are the two stalks of Darbha grass which are used for separating the sacrificial strew from the *prastara*, i.e., the handful of sacrificial grass that represents the Sacrificer.

[122] According to Āp. 4.6.5, these formulas should be recited by the Sacrificer when the two *vidhṛtis* are placed by the Adhvaryu in the middle of the *vedi*. *Cf.* Tait.-Br. 3.3.6.j and Āp. 2.9.13.

[123] According to Āp. 4.7.1, this formula should be recited over the *prastara* by the Sacrificer when the Adhvaryu puts the *prastara* on the *vidhṛtis*. *Cf.* Tait.-Br. 3.3.6.j and Āp. 2.9.13.

[124] According to Āp. 4.7.2, this formula should be recited over the *juhū* by the Sacrificer when the Adhvaryu puts it on the *prastara*. *Cf.* Tait.-Br. 3.3.6.k and Āp. 2.9.15.

[125] According to Āp. 4.7.2, this formula should be recited over the *upabhṛt* by the Sacrificer when the Adhvaryu puts it on the *prastara*. *Cf.* Āp. 2.9.15.

[126] According to Āp. 4.7.2, this formula should be recited over the *dhruvā* by the Sacrificer when the Adhvaryu puts it on the *prastara*. *Cf.* Āp. 2.9.15.

[127] According to Āp. 2.10.3, this formula should be uttered by the Adhvaryu when he places the *sruva* south or north of the *juhū*, after he has put the *juhū*, the *upabhṛt* and the *dhruvā* on the *prastara*.—The *sruva* is addressed. The favorite name of the *sruva* probably is "son of the ones who abound in butter." *Cf.* Tait.-Br. 3.3.6.k.

[128] According to Āp. 4.7.2, this formula should be recited by the Sacrificer when the Adhvaryu places the *sruva* on the *prastara*. *Cf.* Āp. 2.10.3.—The exact meaning of *práthayi prajáyā paśúbhiḥ* is doubtful because *práthayi* is an irregular form. It may be an irregular form of the third pers. sing. injunctive passive of *prathayati*, and in that case the literal translation would be "let it be spread with offspring and cattle," i.e., "let spreading with offspring and cattle take place (for me)." But I think that it is to be considered as a form of the first person sing. injunctive middle of *prathayati*. Sāyaṇa explains *práthayi* by *prathitaḥ syām*. *Cf.* TS. 2.1.2.3: *prátheya paśúbhiḥ*.

[129] According to Āp. 4.7.2 and the commentary of Rudradatta, this formula should be recited over the *ājyasthālī* by the Sacrificer when the Adhvaryu places it (near the sacrificial spoons).

[130] According to Āp. 4.8.2, with these formulas, the Sacrificer should touch the sacrificial cake which is assigned to Agni, and which has been placed within the *vedi* by the Adhvaryu; or, with the same formulas, he should touch all the oblations.

[131] According to Āp. 4.8.3, with this formula, the Sacrificer should touch the cooked sweet milk of the *sāṃnāyya*-offering when that sweet milk is placed by the Adhvaryu, along with the sour milk of that offering, north of the sacrificial spoons. *Cf.* Āp. 2.11.8.

(*u*) "Here is that bright honey, rich in invigorating power, which went to the earth, (and) entered it,—(that bright honey) by means of which Prajāpati poured strength into Indra, by means of which, from above, he nourished (and strengthened) the Great Indra. (So) let the sour milk nourish (and strengthen) me." [132]

(*v*) "This *veda* found out the earth, that was hidden in an inaccessible place, in the lowest depths. Let it find a free space for the Sacrificer. Let the very busy one (i.e., the *veda*) make the sacrifice free from defect." [133]

(*w*) "This sacrifice, rich in offerings, has sat down in readiness together with the Ṛc (the stanza), the Sāman (the melody), the Yajus (the sacrificial formula), and the deities. By it may we conquer free spaces. May I obtain the friendship of Indra, and immortality." [134]

(*x*) "That one who to us, to me, the Sacrificer, would wish deficiency here at this sacrifice,—that one let Indra and Agni drive away from the world. May I obtain progeny rich in manly sons." [135]

(*y*) "O Agni, conqueror of invigorating power, thee who art about to hasten towards invigorating power, and who art about to conquer invigorating power, thee who art rich in invigorating power, thee the conqueror of invigorating power, thee I sweep for the conquest of invigorating power, thee Agni, the eater of food,—for food (i.e., in order that I may obtain food)." [136]

(*z*) "Father Heaven is called hither; may Father Heaven call me. Agni (is called hither) on account of his function of Āgnīdhra, (and may he call me,) for long life, for vital power, for life, for merit (i.e., in order that I may obtain long life, vital power, life, and merit).—Mother Earth is called hither; may Mother Earth call me. Agni (is called hither) on account of his function of Āgnīdhra, (and may he call me,) for long life, for vital power, for life, for merit."

(*aa*) "Let the mind enjoy the light, (let it enjoy) the clarified butter. Let it unite (the parts of) the sacrifice (if it is) interrupted. Let Bṛhaspati perform this (sacrifice) of ours. Let the Viśve Devāḥ rejoice here." [138]

(*bb*) "Of that one whom I cut off from thee, O Agni, or (by whom) I was abused while I was engaged (in the sacrifice) (?),—of that one, O gods, do you cut down the offspring and the foundation.—O Agni, of that one who is hostile to us,—whether he be a man of our own kin or a foreigner,—of that one, just as of fuel that burns up, may nothing be left.—The one who hates me, O Jātavedas, the one whom I hate and who

[132] According to Āp. 4.8.3, with this formula, the Sacrificer should touch the sour milk of the *sāmnāyya*-offering, when that sour milk is placed by the Adhvaryu north of the sacrificial spoons.—The expression "that bright honey" designates the sour milk. It is said that it entered the earth, because it has been poured into an earthen vessel. The exact meaning of *vājinīvat* is not certain.

[133] According to Āp. 2.11.10, this formula should be uttered by the Adhvaryu when, before the recitation of the *sāmidhenī* stanzas by the Hotar, he places the *veda* (i.e., the bunch of strong grass that is used for sweeping the fire places, etc.) either to the east or to the north of the *dhruvā*.

[134] According to Āp. 4.8.4, with this formula the Sacrificer should touch all offerings (i.e., the sacrificial cakes and the other offerings) when they all have been placed within the *vedi* by the Adhvaryu.

[135] According to Āp. 4.8.5, with this formula, the Sacrificer should touch the sacrificial cake assigned to Indra and Agni.

[136] This formula should be recited by the Āgnīdhra when he sweeps the three enclosing-sticks of the Āhavanīya fire after the first *āghāra*. *Cf.* Āp. 2.3.1. *Cf.* Tait.-Br. 3.3.7.d.—Caland translated: "O Agni, der du den Sieg davon trägest," etc. Certainly the word *vāja* sometimes may be translated by "the prize of victory" or even by "victory." But I believe that this is a secondary meaning. I think that the original meaning of the word is "invigorating power," and that this original meaning should be maintained here as in many other passages. My opinion is based on the following reasons: (1) it is certain that *vāja* is etymologically related with Sk. *ugrá* and *ójas*, and with Lat. *augeo* and *vigor*; (2) in most of the commentaries *vāja* is explained by the word *ánna*, and this explanation is already to be found in the TS (2.5.7.2) and in the Śat.-Br. (1.4.1.9); (3) it seems to me that when Agni, the eater of food, is invoked in order to obtain food, it is more natural to call him "the conqueror of invigorating power" than "the conqueror of the prize of victory." *Cf.* Gonda, *Epithets in the Rgveda*, 145.

[137] According to Āp. 4.11.2, the Sacrificer should recite these two formulas, as special formulas, when he touches that part of the sacrificial cake which is assigned to the Āgnīdhra (and which is called the *ṣadavatta*). *Cf.* Tait.-Br. 3.3.8.e and f.—*agnír āgnīdhrāt*. Caland translated: "Agni (bin ich) aus Kraft des Āgnīdhra-dienst." And Eggeling translated the corresponding passage of the Śat.-Br.: "Agni (am I) by virtue of my Āgnīdhraship." But it seems difficult to admit that the most important words of the sentence, namely "I am," should have been omitted by ellipsis; and I prefer to believe, with Sāyaṇa, that the words *úpahūtaḥ* and *úpahvayatām* of the preceding sentence are understood. In a rite that concerns the Āgnīdhra, it is quite natural that Agni should be invoked, and that it should be said that he is called because he is the Āgnīdhra (of the gods). *Cf.* RV. 2.1.2 and 10.91.10.

[138] According to Āp. 3.3.2, this formula should be recited when, after eating the *iḍā*, the Hotar, the Adhvaryu, the Brahmán, the Āgnīdhra, and the Sacrificer purify themselves with water inside the *vedi*. According to Baudh. 3.18, only the Sacrificer should recite the formula.

hates me, those whom I hate and who hate me, do thou burn them all up, O Agni."

(*cc*) "O Agni, conqueror of invigorating power, thee who hast hastened towards invigorating power, and who hast conquered invigorating power, thee who art rich in invigorating power, thee the conqueror of invigorating power, thee I sweep for the conquest of invigorating power, thee, Agni, the eater of food,—for food (i.e., in order that I may obtain food)." [140]

(*dd*) "Let the *vedi*, the sacrificial strew, the cooked sacrificial substance, the fuel, the enclosing-sticks, the sacrificial spoons, the clarified butter, the sacrifice, the stanzas, the sacrificial formulas, and the exclamations *vaṣaṭ*,—(and) the bowings (i.e., the favorable dispositions) (of all those things) bow to me, after the cord used for fastening the fuel together has been offered (i.e., thrown on the Āhavanīya fire)." [141]

(*ee*) "From heaven a post has been stretched down; out of the earth it has risen. By means of that, which consists of a thousand parts, we cause the one who hates us to suffer pain. Let the one who hates me suffer much pain. (But) I, O plant, may I not suffer (any) pain." [142]

(*ff*) "O sacrifice! Homage to thee, O sacrifice! Homage and homage to thee, O sacrifice!—Do thou come to a conclusion, for me, with that which is propitious. Do thou come to a conclusion, for me, with that which is pleasant. Do thou come to a conclusion, for me, with preeminence in holiness. Do thou come to a conclusion after complete success of the sacrifice.—Let homage to thee come, O sacrifice; let homage to thee come; let homage to thee come!" [143]

(*gg*) "That which, of the thrice cleansed grains, remains adhering, let the waters carry that off from here as the share of the Rakṣases." [144]

(*hh*) "That which has stuck to the mortar, to the pestle, and to the winnowing basket, to the lower mill-stone, and to the potsherd, the dropped particles (of flour), the dropped and scattered particles (of flour), (all that) I offer together. Let the Viśve Devāḥ enjoy this oblation. The many dropped and scattered particles, (dropped) in (the course of) the sacrifice, I offer them all, well offered, well presented as an oblation, in the fire." [145]

(*ii*) "Rising today, O thou who hast the might of Mitra, thou hast destroyed my rivals. By day, do thou beat them with thy flashing light. Going down, put them down (i.e., cause them to fall down)." [146]

(*jj*) "Rising today, do thou distribute (thy gifts) to us like a father to his sons. Thou certainly disposest of long-livedness; give us thereof, O Sun!"

(*kk*) "Rising today, O thou who hast the might of Mitra, (and) ascending the higher sky, do thou drive away my heart-disease and my jaundice."

(*ll*) "Into the parrots and into the *ropaṇākās*

[139] According to Āp. 4.11.5, these formulas should be recited by the Sacrificer when the kindling-stick that has been set apart for the after-offerings, is put on the Āhavanīya fire.—The meaning of *ahāṃ vā kṣipitáś cáran* is very doubtful. Caland supposed that the text is corrupt, and did not translate it.—Sāyaṇa explains *prakṣāyataḥ* by *pradāhena kṣīyamāṇasya*, and Caland translated it by "wegschwindend"; but *prakṣāyataḥ* is certainly not from *pra-kṣi* "to destroy"; it is from *pra-kṣā* "to burn up," "to be consumed."

[140] This formula should be recited by the Āgnīdhra when he sweeps the three enclosing-sticks of the Āhavanīya fire before the after-offerings take place. *Cf.* Āp. 3. 4. 7. *Cf.* Tait.-Br. 3.3.8.h. *See* my note on 3.7.6.y.

[141] According to Āp. 4.11.6, this formula should be recited by the Sacrificer over the cord used for fastening the fuel together, when, at the time of the after-offerings, that cord is thrown on the Āhavanīya fire.

[142] According to Āp. 4.12.8, this formula should be recited by the Sacrificer when, after the *sūktavāka* but before the *śaṃyuvāka*, the Adhvaryu throws on the fire the blade of Darbha grass which he already has taken from the *prastara* and set apart. *Cf.* Āp. 3.6.5 and 3.7.5.

[143] According to Āp. 4.12.10, these formulas should be uttered by the Sacrificer while the Hotar recites the *śaṃyuvāka*, i.e., the invocation of health and wealth. *Cf.* Tait.-Br. 3.3.8.i and 3.5.11.

[144] According to Āp. 1.21.2, this formula should be recited by the Adhvaryu when, after having washed the cleansed rice-grains for the preparation of the sacrificial cakes, he pours out the wash-water on the *utkara* (i.e., on the heap of rubbish).—Since *āpaḥ* may be a nominative or a vocative, it is impossible to decide whether the imperative *prá vahatād* should be interpreted as a second or a third person plural. Caland translated it as a third person plural, but, according to Sāyaṇa it is a second person; he explains: *he, āpaḥ . . . pravahatāt prakarṣeṇā 'nyatra nayata. Cf. āpaḥ . . . devéṣu naḥ sukṛ́to brūtāt:* "ye waters, announce us to the gods as well-doers."

[145] According to Āp. 3.10.1, these formulas should be recited by the Adhvaryu when, immediately after or before offering the chaff produced by the husking of the rice, he offers, with clarified butter, in the Dakṣināgni, some of the particles of flour which remained stuck to the implements of the sacrifice.

[146] According to Āp. 4.15.1, this stanza and the five following ones should be recited by the Sacrificer when, after the ceremony of the Viṣṇu-steps, at the end of the sacrifice, he pays reverence to the sun. Before reciting these stanzas he should recite TS. 1.6.6.a–e.

we lay my jaundice; and also into the *hāridravas* we lay my jaundice down." [147]

(*mm*) "The sun here has risen with all his might, delivering my enemy into my hands. May I not fall into the hands of my enemy."

(*nn*) "Whoever shall curse us when we do not curse (him), and whoever shall curse us when we curse (him), to him let Morning and Evening bring every evil."

(*oo*) "Of that one who is our rival, who, (as) a fighter, a mortal, tries to harm us, O gods,—of that one, just as of fuel that burns up, may nothing be left." [148]

(*pp*) "Having been let loose, fly forward, (like) an arrow, sharpened by the Bráhman (i.e., by the holy power of the sacred word). Go to our enemies and enter them. Do not spare anyone of them." [149]

3.7.11

(*a*) bráhma pratiṣṭhā́ mánaso bráhma vācáḥ, bráhma yajñā́nāṁ havíṣām ā́jyasya; átiriktaṃ kármaṇo yác ca hīnám, yajñáḥ párvāṇi prátirann eti kalpáyan; svāhākṛtā́ "hutir etu devā́n.

(*b*) áśrāvitam atyáśrāvitam, vaṣaṭkṛtam aty-ánūktaṃ ca yajñé, átiriktaṃ kármaṇo yác ca hīnám, yajñáḥ párvāṇi prátirann eti kalpáyan; svāhākṛtā́ "hutir etu devā́n [1].

(*c*) yád vo devā́ atipādáyāni, vācā́ cit práyatam devahéḍanam, arā́yó asmā́ṁ (*corr.*: árāvā yó 'smā́ṁ)[150] abhí ducchunāyáte, anyátrā 'smán marutas tán nidhetana.

(*d*) tatā́ṃ ma ā́ 'pas tád u tāyate púnaḥ, svādiṣṭhā dhītír ucáthāya śasyate; ayáṁ samudrá utá viśvábheṣajaḥ; svāhākṛtasya sám u tṛpṇuta rbhuvaḥ.

(*e*) úd vayáṃ támasas pári [jyótiṣ páśyanta úttaram, devā́ṃ devatrā́ sū́ryam áganma jyótir uttamā́m].

(*f*) úd u tyáṃ [jātávedasaṃ devā́ṃ vahanti ketávaḥ, dṛśé viśvā́ya sū́ryam].

(*g*) citrám [devā́nām úd agād ánīkaṃ cákṣur mitrásya váruṇasyā 'gnéḥ, ā́prā dyā́vāpṛthiví antárikṣaṁ sū́rya ātmā́ jágatas tasthúṣaś ca] [2].

(*h*) imā́ṃ me varuṇa [śrudhī hávam adyā́ ca mṛḍaya, tvā́m avasyúr ā́ cake].

(*i*) tát tvā yāmi [bráhmaṇā vándamānas tád ā́śāste yájamāno havírbhiḥ, áheḍamāno varuṇe 'há bodhy úruśaṁsa mā́ na áyuḥ prámoṣīḥ].

(*j*) tvā́ṃ no agne [váruṇasya vidvā́n devásya héḍo 'va yāsīṣṭhāḥ, yájiṣṭho váhnitamaḥ śóśucāno víśvā dvéṣāṁsi prá mumugdhy asmát].

(*k*) sá tvā́ṃ no agne ['vamó bhavo 'tí néḍiṣṭho asyā́ uṣáso vyùṣṭau, áva yakṣva no váruṇaṃ rárāṇo vīhí mṛḍīkáṁ suhávo na edhi].

(*l*) tvā́m agne ayā́ 'si, [ayā́ sán mánasā hitáḥ, ayā́ sán havyám ūhiṣe, ayā́ no dhehi bheṣajám].

(*m*) prájāpate [ná tvád etā́ny anyó víśvā jatā́ni pári tā́ babhūva, yátkāmās te juhumás tán no astu vayáṁ syāma pátayo rayīṇā́m].

(*n*) imā́ṃ jīvébhyaḥ paridhī́ṃ dadhāmi, mái 'ṣāṃ nú gād áparo árdham etā́m, śatā́ṃ jīvantu śarádaḥ purūcī́ḥ, tiró mṛtyúṃ dadhatāṃ párvatena.

(*o*) iṣṭébhyaḥ svā́hā, vāṣaḍ ániṣṭebhyaḥ svā́hā, bheṣajā́ṃ dúriṣṭyai svā́hā, níṣkṛtyai svā́hā, dáurārddhyai svā́hā, dáivībhyas tanū́bhyaḥ svā́hā [3], ṭddhyai svā́hā, sámṛddhyai svā́hā.

(*p*) yáta indra bhāyāmahe, táto no ábhayaṃ kṛdhi, mághavañ chagdhí táva tán na ūtáye, ví dvíṣo ví mṛdho jahi.

(*q*) svastidā́ viśā́s pátiḥ, vṛtrahā́ vimṛdhó vaśī́, vṛ́ṣé 'ndraḥ purā́ etu naḥ, svastidā́ abhayaṃkarāḥ.

(*r*) ābhír gīrbhír yád áto na ūnā́m [4], ā́pyāyaya harivo várdhamānaḥ, yadā́ stoṭṛ́bhyo máhi gotrā́ rujā́si, bhūyiṣṭhabhā́jo ádha te syāma.

(*s*) ánājñātaṃ yád ā́jñātam, yajñásya kriyáte míthu, ágne tád asya kalpaya, tvā́ṁ hí véttha yathātathám.

(*t*) púruṣasaṃmito yajñáḥ, yajñáḥ púruṣasaṃmitaḥ, ágne tád asya kalpaya, tvā́ṁ hí véttha yathātathám.

(*u*) yát pākatrā́ mánasā dīnádakṣā ná, yajñásya manvaté mártāsaḥ, agníṣ ṭád dhótā kratuvíd vijānán, yájiṣṭho devā́ṁ ṛtuśó yajāti [5].

[This chapter contains the formulas which the Adhvaryu should recite when, just before the oblation which is called *samiṣṭayajus*, and which may be considered as the conclusive ceremony of the sacrifice, he offers the libations called *sarvaprāyaścittāni* (atonements for everything). According to Sāyaṇa's commentary, the number of these formulas is 28. In the corresponding passage of Āpastamba (Āp. 3.11.2–3.13.1.a),

[147] The *ropaṇākās* and the *hāridravas* are birds.

[148] According to Āp. 4.16.1, this stanza should be recited by the Sacrificer when, after having paid reverence to the Sun, he pays reverence to the Āhavanīya fire. Before reciting this stanza, however, he should recite TS. 1.6.6.k.

[149] According to Āp. 3.14.3, this stanza may be recited by the Adhvaryu instead of the formulas "I expel that so and so from his home," etc. (Tait.-Br. 3.3.11.3–4), when he hides the poking-stick in the *utkara*. *Cf.* Tait.-Br. 3.3.11.a and b.

[150] *Cf.* RV. 10.37.12.

however, the number of the formulas to be recited on this occasion is 38.]

(*a*) "The Bráhman (the holy power of the sacred word) is the foundation of the mind; the Bráhman is the foundation of speech; the Bráhman is the foundation of sacrifices, of oblations, and of the clarified butter (offered to the gods). That which of the religious performance is superfluous, and that which is insufficient,—the sacrifice, extending its joints, sets that in order. Let the oblation offered with the exclamation svāhā go to the gods."

(*b*) "The call (i.e., the call addressed to the Āgnīdhra by the Adhvaryu), (if it is) excessively lengthened, and the exclamation vaṣaṭ (i.e., the exclamation vaṣaṭ uttered by the Hotar at the end of the oblation-formula), (if it is) excessively loud, at the sacrifice,—that which of the religious performance is superfluous, and that which is insufficient,—the sacrifice, extending its joints, sets that in order. Let the oblation offered with the exclamation svāhā go to the gods."

(*c*) "If I do commit an offense against you, O gods, an offense against the gods, caused by any word, do you put that, O Maruts, on another than ourselves, on the one who, being envious, wishes to harm-us."

(*d*) "My work has been accomplished; it will be accomplished again. The sweetest pious thought is expressed for praise. This is an ocean, and it contains all remedies. Refresh yourselves, O Ṛbhus, with the oblation that is offered with the exclamation svāhā." [151]

(*e*) "Gazing on the higher light, on Sūrya (the Sun), a god among the gods, we, from darkness, have come to the highest light." [152]

(*f*) "His rays bear him upwards, the all-knowing god, Sūrya (the Sun), that all may look at him." [153]

(*g*) "The radiant face of the gods has risen, the eye of Mitra, Varuṇa, and Agni. He has filled the sky and the earth, and the atmosphere, —Sūrya (the Sun), the soul of all that moves and stands." [154]

(*h*) "Hear this my call, O Varuṇa, and be merciful today. Desirous of help, I long for thee." [155]

(*i*) "This I implore of thee, worshipping thee with the holy power of the sacred word. For this, the Sacrificer prays with his offerings. Be here, not angry, O Varuṇa. O far-ruling one, do thou not take away our life." [156]

(*j*) "Mayest thou, O Agni, knowing (how to do it), avert from us the wrath of the god Varuṇa. Being the best worshipper, the best carrier (of the oblations), do thou, flaming brightly, free us from all hostilities." [157]

(*k*) "So, O Agni, be nearest to us with thy help, nearest (to us) at the (first) gleam of this dawn. Do thou, for us, appease Varuṇa by sacrifice, bestowing (thy gifts) (on him). Show compassion. Be thou, for us, easily to be won by invocation." [158]

(*l*) "Thou art agile, O Agni. Being agile, (thou art) impelled by the mind. Being agile, thou carriest the oblation. (Being) agile, do thou give us remedy."

(*m*) "O Prajāpati, none other than thou encompasseth all these creatures. For whatever object of desire we sacrifice to thee, let that be ours. May we be lords of riches." [159]

(*n*) "This fence I put for the living. Let not another of them go now to that side (of it). May they live a hundred full autumns. Let them shut out death from themselves by a mountain." [160]

(*o*) "To those to whom the sacrifice has been offered, svāhā!—Vaṣaṭ! To those to whom the sacrifice has not been offered, svāhā!—Remedy! To the sacrificial act that has been badly performed, svāhā!—To restoration, svāhā!—To want of success, svāhā!—To the divine bodies, svāhā!—To success, svāhā!—To complete success, svāhā!"

(*p*) "From what we fear, O Indra, give us absence of fear. O generous one, be able to accomplish that (deed) of thee for our help. Do thou destroy our enemies; do thou destroy our scorners." [161]

(*q*) "Let the giver of well-being, the lord of the the people, the slayer of Vṛtra, the god who wards off the scorners, the powerful, the bull Indra, go in front of us, giving well-being, procuring security." [162]

(*r*) "Whatever of this (sacrifice) of ours has been deficient, do thou cause that to swell, O god with the bay horses,—being strengthened by

[151] *Cf.* RV. 1.110.1.
[152] = RV. 1.50.10.
[153] = RV. 1.50.1.
[154] = RV. 1.115.1.
[155] = RV. 1.25.19.
[156] = RV. 1.24.11.
[157] = RV. 4.1.4.
[158] = RV. 4.1.5.
[159] = RV. 10.121.10.
[160] *Cf.* RV. 10.18.4; AV. 12.2.23; Śat.-Br. 1.3.8.4.
[161] *Cf.* AV. 19.15.1.
[162] *Cf.* RV. 10.152.2. *Cf.* AV. 1.21.1.

these songs. When, for thy praisers, thou breakest open the great stables, then may we receive the greatest share."

(*s*) "Whatever of the sacrifice, unknowingly or knowingly, is performed in the wrong way, that of this (sacrifice), O Agni, do thou set in order, for thou knowest what is right."

(*t*) "As great as the man is, is the sacrifice. The sacrifice is as great as the man is. (Whatever of this sacrifice is performed in the wrong way,) that of this (sacrifice), O Agni, do thou set in order, for thou knowest what is right."

(*u*) "What of the sacrifice, men, in their simplicity, being weak-minded, do not understand, Agni, the wise Hotar, knowing that, (and being) most skilled to offer, will duly offer to the gods." [163]

[163] = RV. 10.2.5.

KOURION: THE THEATER

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INTRODUCTION

DURING the summer of 1954 I was given the opportunity of studying for publication the theater of Kourion, excavated by the expedition of the University Museum, University of Pennsylvania. The excavations had been begun by J. F. Daniel, in the season of 1935, and were completed on a large scale by Mr. DeCoursey Fales in the spring and autumn of 1949, and again in the spring of 1950. During these last years practically the entire structure was laid bare. Mr. Fales's notebooks were placed at my disposition and proved to be of great value. The survey plan, together with various details, had been drawn by Mr. Cristophis Polycarpou, the architect of the expedition, and I had the benefit of his further assistance in the summer of 1954. Only a small amount of probing, and some necessary cleaning up was done, but several interesting details came to light. The study was, however, complicated by the fact that no complete architectural inventory came into my hands, and while the former excavators had carefully numbered a large number of architectural blocks, four seasons of Cypriote weathering had obliterated almost all of the markings. Many of the pieces had not been fully drawn up, and the limited space available for stacking the fragments brought about a piling up that made identification and full measurement extremely difficult. Certain portions of the ruins of the building were also made inaccessible.

As the theater of Kourion is one of only two Roman theaters in Cyprus that have been excavated[1] it is an important example of the Roman Provincial buildings of this kind, and it has the added advantage of having a Hellenistic predecessor, of which, unhappily, there are only fragmentary remains.

It is only fitting to express here my recognition to Professor Rodney S. Young, and to Professor Roger Edwards, both of the University Museum. The former made my visit to Cyprus possible, and the latter guided me over the ruins of Kourion and also was a most courteous and effective host at Kourion House. Mr. J. S. Last, our near neighbor and a friend of the Expedition, gave much of his time in checking the surveys, and provided a great deal of constructive comment and criticism. Mr. Polycarpou redrew or added to a number of the plans; Christo Grigoriou, our foreman, was both willing and efficient, and the several members of our household staff deserve much thanks for their friendly cooperation whether in matters routine or extraordinary.

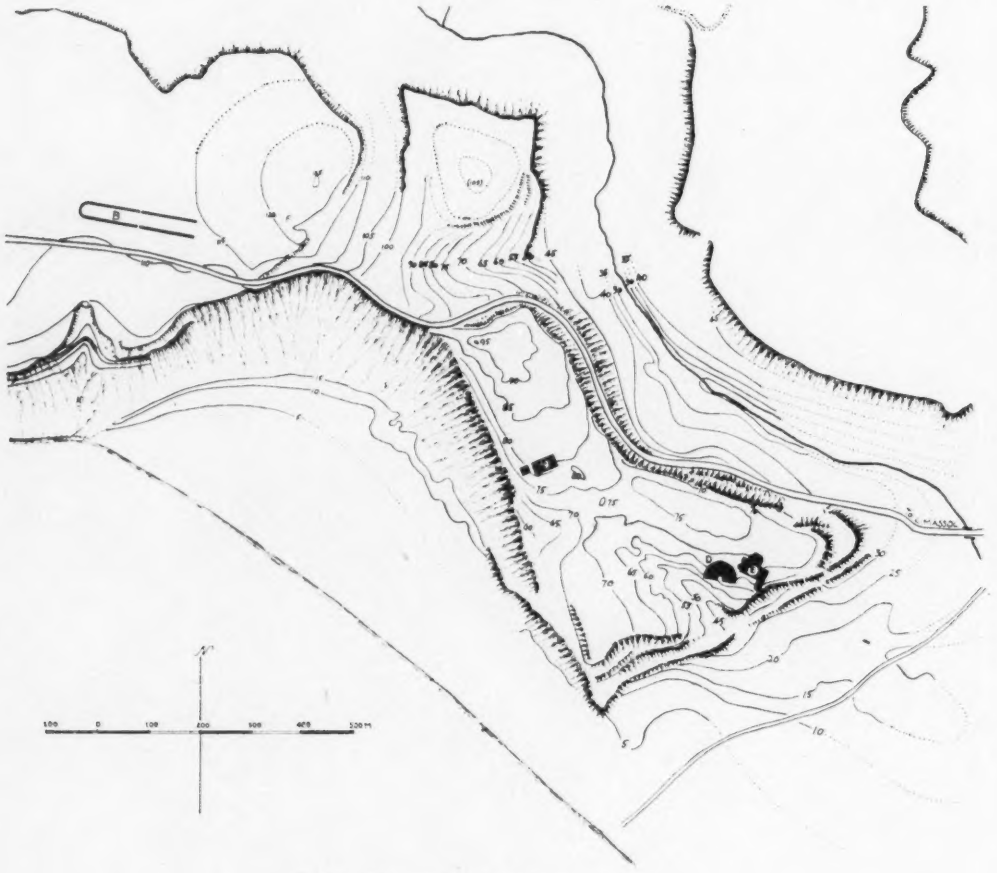
GENERAL DESCRIPTION

Kourion is situated on the south coast of Cyprus overlooking what is now known as Episkopi Bay, just to the west of the low, broad peninsula of Akrotiri. The Acropolis, which seems in later Greek and Roman times to have included the greater part of the city, is formed by the easternmost spur of the high ground and hills which separate this section of the country from the Paphos region farther west. Along the coast, as one travels from Paphos, is a succession of sheer limestone cliffs and promontories with no marginal shelf between them and the sea, but the final one of the series has below it a narrow, low-lying plain less than a quarter of a mile wide. A narrow neck connects this bluff with the high ground on the east. The south side, toward the shore, is steep and, for a large part, sheer. The eastern end is divided into two prongs; between them a narrow valley, less than a hundred yards wide, offers a possible, though steep, approach. Otherwise the heights are practically impossible to scale, and quarrying in ancient times has increased their natural inaccessibility. On the north the same holds true all along until the western connecting neck of land is reached (map 1).

It seems reasonably sure that there were but three practicable ways to reach the Acropolis; an eastern, a southern, and a western entrance. That they were amply defended may be inferred, but thus far the actual location of the west gate is still debatable, while the eastern gate has never been explored.[2]

[1] The other theater is that at Soli. Gjerstad, Einar, *The Swedish Cyprus Expedition* **3**: 548–582, Stockholm, 1937.

[2] Di Cesnola, L. P., *Cyprus: its ancient cities, tombs and temples*, 299, New York, 1877. "The City of Curium



MAP 1. The Acropolis of Kourion.

The entire area, within the perimeter of the walls, covers approximately 300 acres. The distance from the neck at the west to the tip of the spur is almost 1,300 yards; the greatest breadth of the bluff is about 550 yards.

had three entrances, one on the south, one on the west, and a third on the north side, near the present road to Paphos. The first and second are still visible. The southern entrance, or square opening hewn in the rock, is 56 feet wide. A flight of steps led up to the gate, bridge, or whatever else closed this entrance, which is still marked by the fragment of a column standing on its original base.

"The western entrance faces the bay, and seems to have been the principal one; but no traces of steps or a road leading to it can now be seen. . . .

"Entering the city from the *southern* gateway, and walking a few minutes in a north-easterly direction, one meets with the ruins of a semi-circular structure measuring 720 feet in circumference, probably those of a theater."

Di Cesnola's "south entrance" should, to conform with the orientation here used for the theater, become the east entrance; his "west" then becomes south, and is no more visible than when he described the site. The "north" entrance, near the Paphos road, is, in the new terminology, the west entrance. When he moves "north-easterly" from the "south" gate he is, *mutatis mutandis*, going northwest; *cf.* note 3.

Di Cesnola's circumference of 720 feet gives a radius of about 34.9 m. Actually the extreme radius of the theater is very close to 31.00 m. It may be purely coincidence but 34.9 m. is almost precisely the distance from the back of the cavea to the foundation of the pulpitum, measured along the central axis of the theater; and it seems that Di Cesnola actually saw and identified the theater correctly. In 1954 I noted four courses, each about 0.26 m. high, forming the angle of a wall or tower in Di Cesnola's "South Entrance," but no visible remains of a flight of steps.

FIG. 1. The theater from the south.

Di Cesnola [3] noted a broad artificial (?) plateau made by quarrying to the east of, and below the cliffs; there is today a distinct shoulder along the side before reaching the level of the plain. Generally speaking the average height of the defending cliffs is 150 feet; the plateau of the Acropolis is some 230 feet above mean sea level. Somewhere along the shore, very probably where there are yet remains of a breakwater to be seen, was the port, but this has never been explored. If the assumed location is correct, the road between the harbor and the Acropolis would have skirted the southeast spur and entered through the eastern approach.

The theater (fig. 1) lies on the northern slope of the east valley and faces across it toward the south. It is a steep descent to go from the remains of the orchestra directly down to the floor of the ravine and it is doubtless less of a distance now than formerly since the ravine seems to have filled in with the passage of time.

Taking advantage of the nature of the terrain, the axis of the theater lies roughly northeast-southwest.[4] The central section of the cavea is cut in the native rock, as is the entire area of the orchestra together with a large portion of the area which underlay the stage building. The rock itself is the uneven limestone which prevails in the region, hard in places, very soft in others. The cliffs around Kourion show, in their erosion, the same quality as is found in the quarried, worked blocks of the buildings. In the same wall, many blocks are still as sharp and clean as when they were cut, while others have crumbled to powder. In the rock beneath some parts of the cavea and under the scene building and orchestra is a series of caves, for the most part natural, but in many cases enlarged by man. Rectangular stone pillars have been freely inserted to insure the support of the roof, and here and there supporting walls of good rubble construction, or rubble mixed with ashlar, serve the same purpose.

The uses of these caverns (fig. 31) will be considered later. In nearly every case, however,

[3] *Op. cit.*, 294.

[4] The azimuth is 33 degrees. For convenience in description, however, the theater is assumed to face south to the stage, so that the two parodoi will be called respectively east and west.

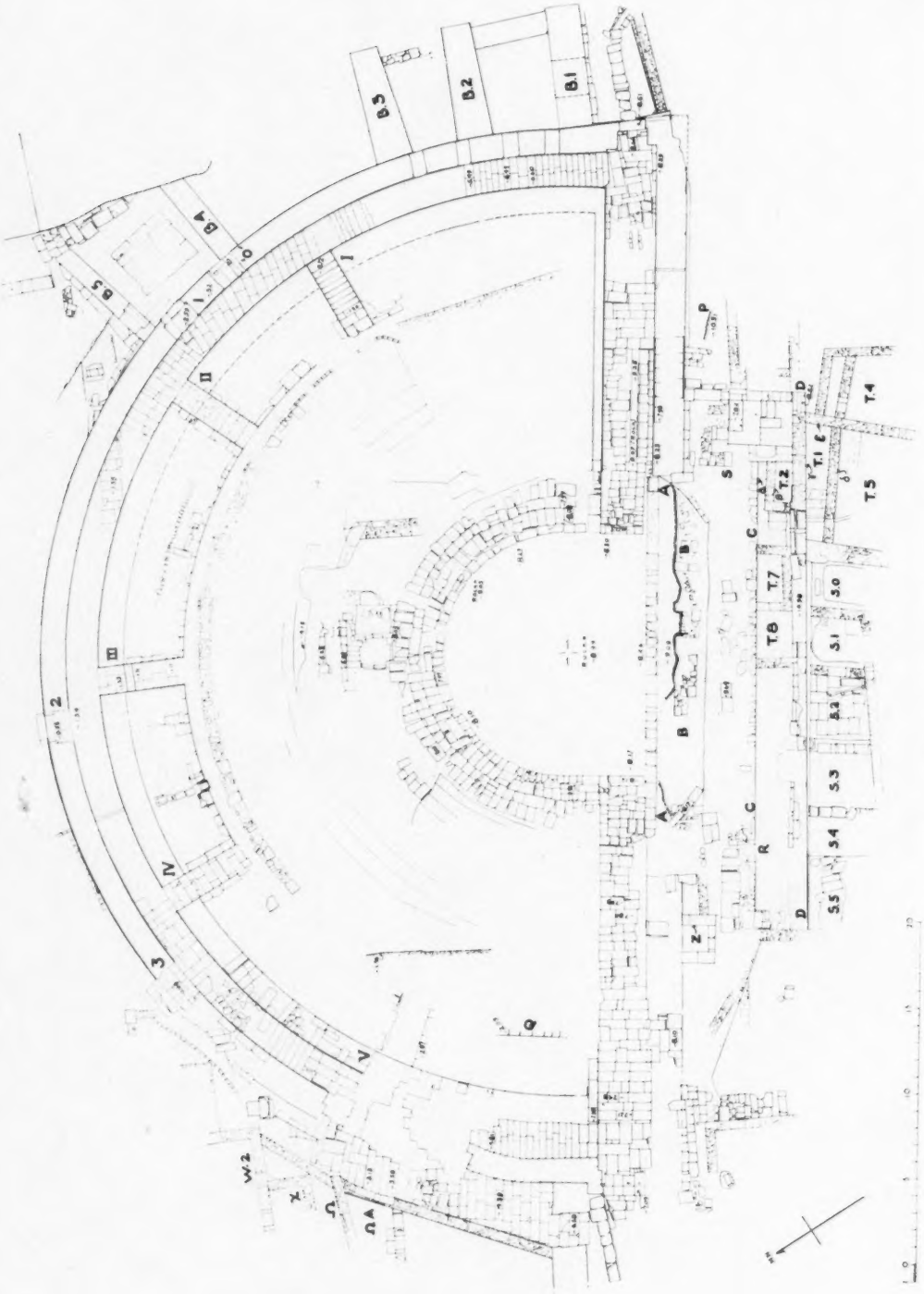


FIG. 2. Plan of the theater, actual state.

they had no immediate relation with the theater as a place of entertainment.[5]

The theater (fig. 2) forms a half circle approximately 62 m. in diameter, extended slightly to the south. From the north side of the analemma to the south face of the back wall of the stage building the distance is 44 m. In the final period, the radius of the orchestra, measured to the lowest row of seats, was 8.50 m.

Within the analemma a vaulted corridor (fig. 3) gave access to five vomitoria leading to the diazoma which separated the lower from the upper maenianum.

The scene building, including the stage, had a depth of only 9.50 m. and a total length, in its final form, of 31.0 m.

Although chronology will be considered more fully later on, some mention should be made at this point concerning the various periods of the building. It will also be clearer if they are noted in reverse order, the latest first.

In its final form, before it was abandoned, the theater at Kourion seems to have been used as a proper theater,[6] equipped with a paved orchestra, a pulpitum, and the usual scaenæ frons. Prior to this phase, which may be said to have lasted from roughly the middle of the third to the final destruction in the fourth century after Christ, there had been a period in which the building was converted into a hunting theater.[7] The level of the orchestra had been lowered and enlarged by cutting away the three or four lower rows of seats. This had, naturally, the effect of creating a high wall surrounding the arena[8] and thus protected the spectators from the animals used in the spectacle. The pulpitum was removed and curved walls built at either side to fill in the angles between the parodoi and the scaenæ frons. Sturdy wooden barriers were set in the opening of each parodos in line with the arena wall. A vaulted refuge with a tribune above was created on the central axis, facing the stage. There seems not

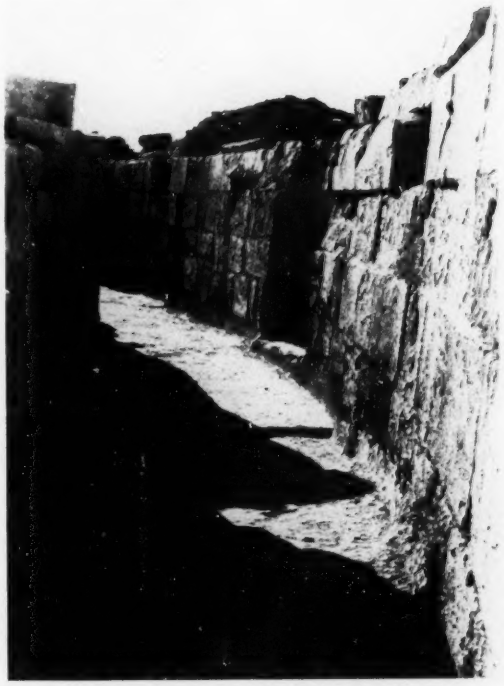


FIG. 3. The corridor, looking west.

to have been any further change of serious nature. The level of the arena lies about 0.80 m. below that of the late orchestra. This change to a hunting theater probably took place early in the third century.

Before this, and presumably dating from soon after A.D. 100, we have a straightforward Roman-type theater, with a rather narrow pulpitum and a scaenæ frons of the straight, Asiatic, or Eastern type (figs. 4, 5, 6). Exedras, semi-circular or rectangular, do not appear. In this period the theater had been considerably enlarged. The establishment of the dromos or corridor, outside of an earlier analemma, provided better access to the seats. The parodoi were rebuilt parallel to the stage building which was, of course, entirely remade.

There would seem to have been, prior to this large theater, a smaller one, with the same location and orientation. Its outer wall lay on a radius of only about 26 m. from the center, and it also had the parodoi placed in the Roman manner, parallel to the stage. There is no indication, however, that they were covered. The stage building

[5] The excavations did not clear any of the caverns except the one under the northeast quadrant (Cave 3).

[6] There is no evidence that there were ever any arrangements for flooding the orchestra, as was done elsewhere, either for *naumachia* or water mimes (κολυμβήθρα). Presumably the difficulty of insuring an adequate water supply to the city made such forms of entertainment impractical.

[7] θέατρον κινητικόν, Dio Cassius, 78, 9, 7.

[8] It would have been about 3.70 m. high. At Corinth the wall measured 3.80 m. See Stillwell, R., *Corinth* 2; fig. 73, Princeton, American School of Classical Studies at Athens, 1952.

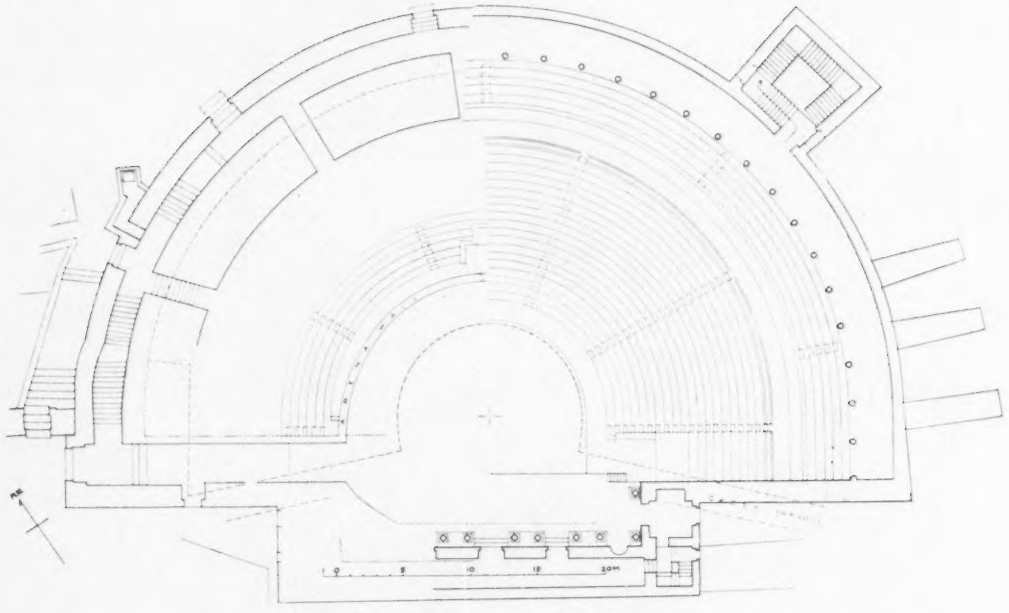


FIG. 4. Restored plan of the theater.

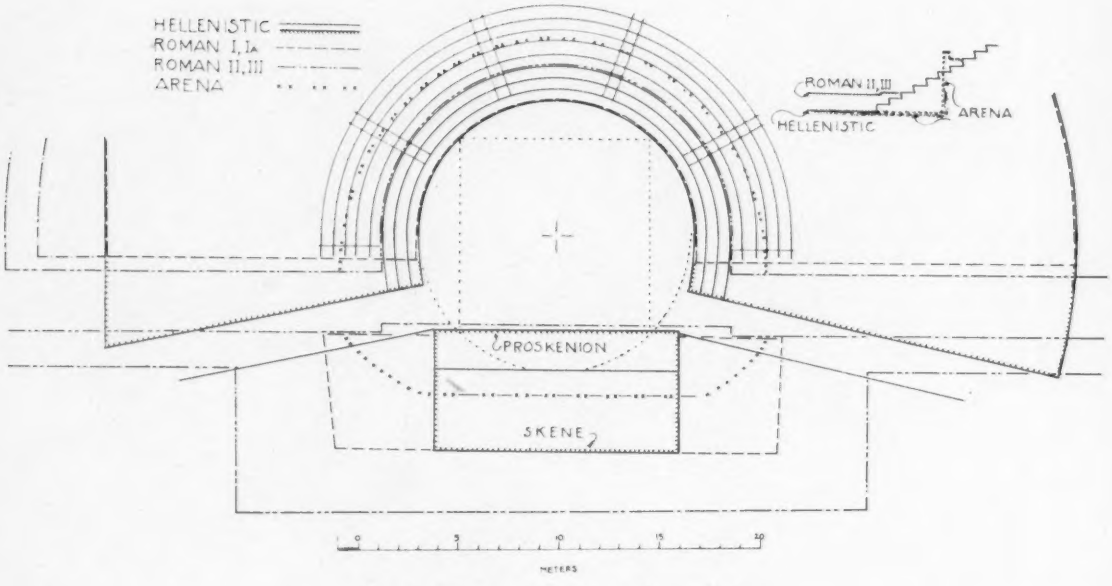


FIG. 5. Diagrammatic plan to show periods.

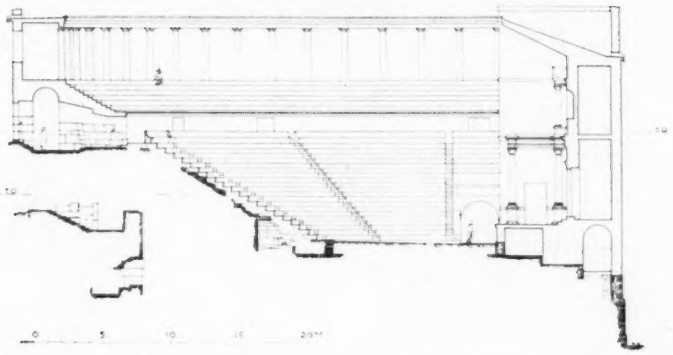


FIG. 6. Sections north to south, actual and restored, and section through corridor on east side.

itself was certainly shorter, and slightly narrower. Of the foundations of the actual stage or pulpitum no easily recognizable traces exist, so complete was the rebuilding and later destruction. This period, which, it would appear, belongs to the Augustan age, was preceded by the earliest of all, which dates from Hellenistic times (fig. 5).

For the latter we can cite an analemma, now buried in the masonry of the larger, later structure. Its stone courses show up at a number of places, and in technique resemble very closely the masonry on a Hellenistic tomb monument at Ayios Ermoyennis.[9] Seat blocks from this period appear as re-used material in the parodos wall of the early Roman period. Half-columns, of a pattern associated with the logeion of the Hellenistic period, as at Priene, are used in the second-century Roman stage foundations, and a single rock-cutting (one could wish for more of it) suggests a terrace for a parodos which, instead of lying parallel to the stage building, angled inward in the normal Greek manner (P, fig. 2). Further evidence for these periods must be considered below. There are no architectural remains which make it possible to carry the history of the theater back to Classic times.

In addition to the parodoi, access to the later theater was through five doorways which opened into the vaulted corridor. Three of these are placed in the northwestern quadrant, the side toward which lay the greater part of the city. Two occur close together in the northeastern section. In connection with the latter there is a massive, square foundation which can best be interpreted as a tower containing a stair to give access to the promenade around the upper rim of the cavea, and thence to the seats of the upper maenianum.

The entrances themselves were reached by stairs, streets, or ramps disposed, so far as the excavated areas show, as follows: At the southwest angle, leading up from the level of a (presumable) street that ran parallel to the foot of the rear wall of the stage building, was a stairway which terminated against the south wall of the west parodos near its outer end. There are no remains to show whether there was a doorway through the wall at this point, for the entire superstructure of the parodos has been robbed. The stair itself appears once to have been fully six meters wide, but later intrusions have narrowed it. It seems altogether probable, however, that this stair served only in the period before the theater was enlarged. Its eastern edge aligns very clearly with the outer line of the analemma of the earlier period, and in that period the same stair would have continued upward past the open parodos to the higher levels to the north. In the enlargement of the theater after A.D. 100 the approach from below was probably arranged still further west. A late wall, roughly built of heavy, re-used blocks, now conceals the entrance to a stair that curves upward outside of the later Roman analemma. This stair was reached by an archway 2.10 m. wide through a massive buttress built against the S.W. angle of the analemma.

The western side of this stairway was bounded by a retaining wall 0.65 m. thick, built of well-laid opus incertum. It is now preserved only to stair level, or a little above, so that its full original height is not recoverable. Further up, however,

[9] McFadden, G. H., A tomb of the Necropolis of Ayios Ermoyennis at Kourion, *Amer. Jour. Arch.* **50**: 449–489 and pl. 35, *b*, 1946.

where a second flight of stairs begins, the parapet above stair level is made of squared blocks, 0.45 m. thick and curved in plan to parallel the curve of the outer wall of the theater. At the top of this flight is a landing 3.00 × 4.00 m. opposite the entrance to a vomitorium (V, fig. 2).

In this area all but the lower foundation blocks of the outer wall, the corridor, and its inner wall have been ripped out, so that any entrance to the corridor at this point must be inferred from the fact that the landing platform would otherwise have no significance. It is quite evident that any further passage along the outer wall leading north and east was narrow, unpaved, and at best only a minor one. It seems, furthermore, to have been blocked by the mouth of a cistern which was reached through a narrow passage from the corridor. This feature will be considered again later in connection with water supply. Skirting the north side of the theater from Entrance 3 to Entrance 1 there was also a street of which the original surface followed approximately the level of the various entrances. In the course of time it rose somewhat through successive layers of fill. At no time does there seem to have been any paving. This street, to which at least one other led, at right angles from the north, seems never to have been more than 3.00 m. wide, but the excavations were not extended far enough out to learn all the details. As the street curved east and south toward Entrance 1, it reached a doorway in a heavy buttressing wall, B.5, which formed at one time the north wall of the stair tower. Entrance 1 is just south of this wall.

East of the theater, a broad street, paved with successive layers of fill, sand, and gravel led up from the south. At first it presumably skirted close to the early analemma, but it was pushed farther away when the theater was enlarged—and still farther when, not long after the enlargement, a series of heavy buttress walls as well as the stair-tower were constructed. This street ran between the theater and the large "palace" and bath complex to the northeast.[10] From this east street there was, of course, direct access to the doorway at the end of the east parados.

Entrances 1 and 3 are well preserved for about half their original height. They average 1.60 m. wide, and on the outside a shallow pilaster strip, 0.30 m. wide, has been worked on the stone. These were probably topped by simple, molded capitals, and carried a horizontal lintel. Within the jambs, double doors, swung on pivots, folded back against the thickness of the wall. The rectangular cuttings for the metal pivot sockets are still well preserved. Entrance 4 is, as has been noted above, entirely pillaged, but the eastern jamb of Entrance 3 is intact. Steps were provided in the thickness of the wall so as to adjust the entrances to the level of the corridor, and a step was also placed on the street side of the sills of the doorways to raise them sufficiently above the outer level to prevent water from cascading into the corridor (fig. 6). One Entrance, "O," calls for special consideration. It seems not to have belonged to the original plan but to have been cut through the wall in connection with the stair tower. It is narrower than the standard (1.20 m. *vs.* 1.60 m.); its location is such that if it were used at the time of the stairs it had to be narrower than the normal openings. Unfortunately a lime-kiln was built just in front of this opening after the abandonment of the theater and the stones on the southeast side are badly calcined.

The two entrances opening on the ends of the parodoi still have to be considered, and the eastern one merits special notice. The plan shows that at this point the outer face of the analemma, instead of lying at right angles to the line of the parodos, forms an acute angle with it. The jambs and the reveals of the doorway are, however, cut so as to parallel the axis of the parodos, and hence the lintel, which took the form of a flat arch of five voussoirs, exhibits an interesting example of stereotomy. The opening between jambs (1.50 m.) conforms to the other entrances, and again the doors were two-valved. Only one pivot socket is preserved, however. The other disappeared during later repairs to the paving. The sill rises 0.15 m. above the level of the floor inside.

There is a retaining wall, of good opus incertum, which makes an acute angle with the analemma at the southeast corner. The fact that it has been built in two stages, as shown by an offset on the north side, suggests that it grew as the filling was placed against the enlarged theater, and that it served to retain the fill which carried the level of the approach to the doorway. Between this wall and a heavy buttress wall 3 to 4 m. farther north is the line of the orchestra drain (fig. 7).

[10] The "palace" did not exist in that form during the life of the theater, but the area was occupied by groups of buildings, probably of a civic-residential nature, while the theater was in use. In following publications of Kourion this complex will be known as the Annex of Eustolios.

The north jamb of the entrance to the west parodos is preserved and, in distinction to the east doorway, has its sill at right angles to the axis of the parodos. Although the south jamb has entirely disappeared, the arrangement of the paving and the sill blocks indicates that it had a width of at least 2.35 m., or 0.80 m. more than the east parodos. This was done, presumably, to provide for the larger number of spectators who came to the theater from the west and northwest where lay the largest part of the town. The Roman builders were practical men and unless compelled to concern themselves with axial symmetry paid greater attention to convenience of circulation.

All the entrances were provided with cuttings in the reveals for stout wooden bars, so that the entire building, when not in use, could be securely closed.

The corridor was established, along with the entrances which have just been considered, at the time when the theater was enlarged about the beginning of the second century. A heavy facing, 1.50 m. thick, was built against the early analemma (fig. 8). The corridor itself was 1.90 m. wide, and the new analemma 1.40 m. thick. Thus the radius of the building was extended 4.80 m. Because of the natural slope of the bedrock the level of the corridor at the back of the theater rises more than seven meters from the paving of the east parados.[11] This necessitated stairs in the corridor, many of which are still well preserved. Beginning at the southeast end, there is a flight of thirteen steps to a landing (fig. 9); then one of seven. Above this point the steps and paving have been robbed, but just before reaching Vomitorium I there are foundations for another flight of seven or eight steps. The floor of the corridor then runs nearly level (slope of 0.07 m. in 9.00 m.) to a set of four more steps just short of Vomitorium II. Four more steps would have been needed beyond the entrance to the vomitorium in order to clear the slabs which cover a passageway beneath the corridor. From here on there was no paving; the floor consisted of the native rock until Vomitorium IV was reached. Farther on, past Entrance 3, eight more steps survive, this time descending, and then, after a few meters, extensive pillaging has destroyed both floor and steps. Only when we come near the west end of the corridor do we find the final flight of steps, again thirteen in number, as at the east (fig. 10).

The pavement at the foot of this last set of steps is 1.45 m. higher than at the foot of the southeastern steps, so that the west parodos

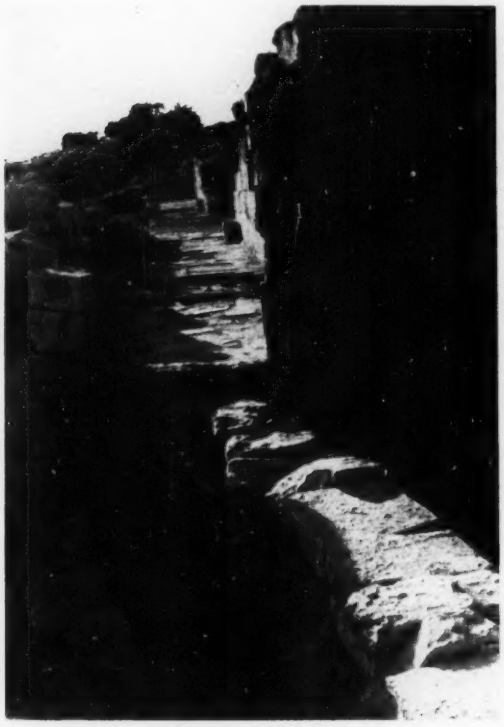


FIG. 7. Entrance to east parodos showing drain and terrace wall.

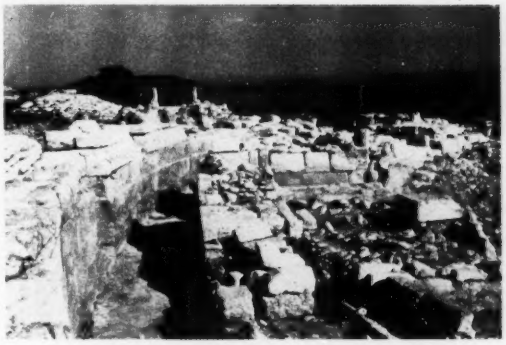


FIG. 8. The corridor, looking east.

[11] This is a compromise between the Greek type theater, built against a hill, and the usual Roman type, whose entire cavea was supported on a series of arches and vaults.

descends slightly toward the orchestra whereas the east parodos slopes gently away from it.

There is a peculiar irregularity in the plan, as an inspection will show (fig. 2). The first seven meters of the outer wall at the west runs straight for part of its length and then curves sharply to join with the normal trace of the inside face of the wall farther north. Unfortunately, this adjoining section is lacking, and the rock and subfoundations give no hint of how the two curves were joined. It is also noticeable that the first flight of steps at the west is about 0.30 m. wider than at the east. The preserved section of the outer, west wall is 0.10 m. thinner than the corresponding portion at the east, and so is the inner wall. Only for its last meter and a half does it appear to have resumed the normal thickness of 1.50 m., but this can only be deduced from the preserved ends of the paving blocks at the foot of the lowest step, and it is not absolutely certain, though very probable, that they were not pieced out by narrow chinking pieces. Whether this irregularity has especial significance is doubtful.

FIG. 9. Stairs at southeast extremity of corridor.

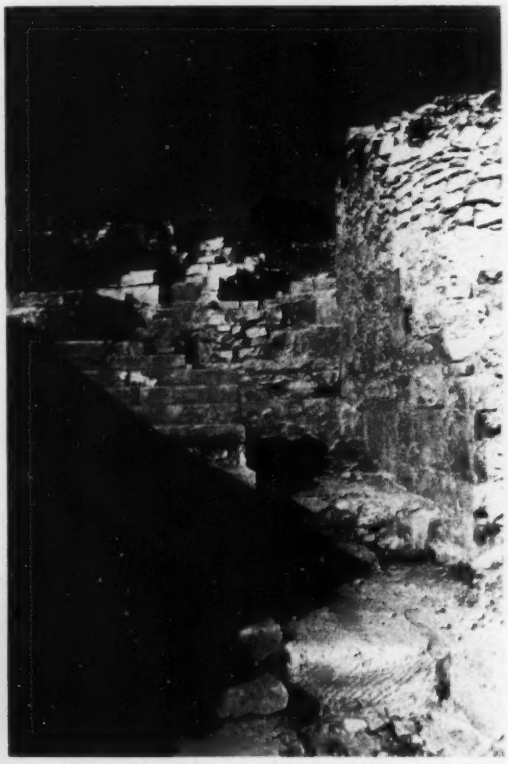


FIG. 10. Stairs at southwest extremity of corridor.

The process of "wrapping" an enlargement around an existing structure is apt to lead to some irregularity. The construction of the inner and outer walls of the corridor will be considered below under *construction*. This is, however, the place to note the steps and paving of the passage. The steps have an average rise of about 16.6 cm. They vary from 15.8 cm. on the east to 17.3 cm. on the west. The treads are normally 35 cm. wide,[12] and are not laid on radii of the theater circle, but with the risers parallel, as may be seen from the plan.[13] Such paving as remains is also laid for the most part in parallel lines, as may be seen north of Vomitorium I, and it may also be noted that both steps and paving were inserted after the walls at either side had been laid.

[12] The unusually low ratio of rise to tread, about 1:2, makes the corridor stairs very easy to ascend.

[13] As a result of this, one end of the first step at the east projects into the fairway of the parodos and, to avoid tripping, has been very neatly rounded off.

Since corridor and parodoi were covered with barrel vaults (of which a number of voussoirs have been found) adequate lighting had to be provided. Along the eastern part of the passage, four rectangular openings, low down close to stair level, admitted light to what would otherwise have been a dangerously gloomy section.[14] The windows are 0.82 m. to 0.84 m. wide, and about 1.15 m. high. The lower half of each opening was closed by a thin slab set flush with the outer face of the wall. No other traces of windows can be seen elsewhere, but it would be reasonable to assume that there was a similar arrangement at the west. There is now no indication of further lighting provisions in the corridor. Some light would have entered through the doorways from the outside, and some from the vomitoria, but it is probable that other openings, no longer preserved, were provided.

FIG. 11. Buttresses B.1, B.2 and B.3, against eastern portion of analemma.

Soon after the theater was enlarged, but probably while it was still under construction, a series of three powerful buttresses (B.1, B.2, B.3 on fig. 2; fig. 11) were built against the southeastern portion of the outer wall. Two more, B.4, B.5, were erected against the northeast quadrant and incorporated with a stairtower, and one, already mentioned, was placed against the southwest angle. This last, it will be recalled, had an opening through it to afford access to an exterior stair. There was no door, but the reveals of the opening were decorated with shallow, recessed panels. The buttress was 2.10 m. thick and projected at least six meters.

[14] This is an eminently practical device. The light is most needed on the steps themselves.

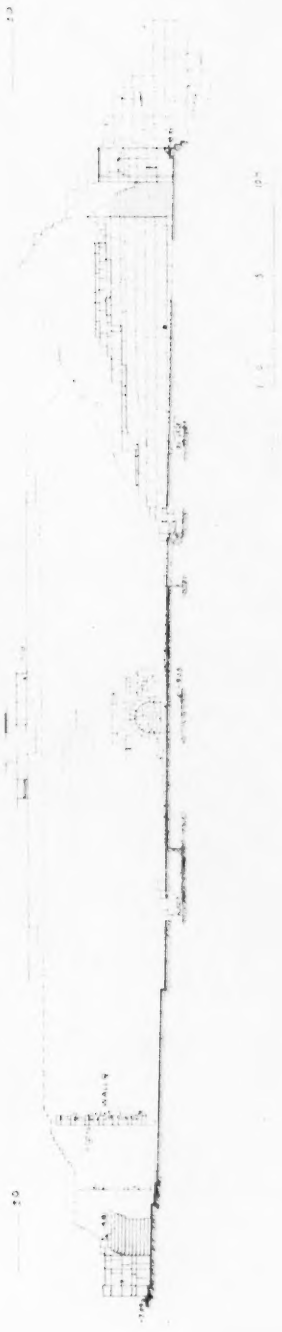


FIG. 12. East-west section, looking north.

A similar opening was planned and begun in Buttress B.1, at the east (fig. 12).[15] From the way in which the courses which fill the opening range with those to either side, and from the absence of any lintel or arch above the opening, it seems that the idea of leaving a passageway similar to the one at the west was abandoned while the buttress was still incomplete. Furthermore, Buttresses B.2 and B.3, which from their construction cannot be later than B.1, had no passage through them. All three eastern buttresses rest on heavy foundations which go down to bedrock. This was shown by soundings between B.2, B.3 and on the south side of B.1. It is also very apparent why they were installed. The cavea wall had been pushed out of plumb and was actually leaning when the supports were placed against it. In fact, it is probable that a partial collapse had taken place. The reason was two-fold. First, the vault over the corridor came at a high level; there was too great a height of wall below for stability; second, the foundations of that sector of the outer wall had been shockingly scamped. They rest on a loose rubble fill with earth between them and bedrock. The builder who placed the buttresses aligned his upper footing courses very nearly with those of the ring-wall, but below them he carried coursed ashlar down to rock. The theory that a collapse may have occurred is suggested by the liberal and careless re-use of material in the analemma which can be seen between Buttresses B.2, B.3.

Against the northeast quadrant were two more buttresses, B.4, B.5, 6.00 m. apart, which enclosed between them a powerful, rectangular foundation, 4.00 m. by 3.00 m., built of squared blocks laid in mortar. This foundation was entirely surrounded by a band of rubble packing which filled the spaces between it and the buttress walls, the wall of the cavea and, presumably, a closing wall to the northeast (fig. 13).[16]

The foundations of Buttresses B.4 and B.5 resemble those of B.1–B.3 and they are certainly contemporary. Both are built against, and do not bond with, the analemma. The same is true of the upper part of Buttress B.5, but it differs from B.2–B.3 in being thinner, as it is only 1.18 m. thick. It is, furthermore, pierced by a doorway, 1.40 m. wide, close to the analemma. The doors, which were double, opened in toward the tower-room, and the fact that there were doors shows clearly that we are dealing with an enclosed space and not merely an opening through a buttress for convenience of circulation. A rubble retaining wall served to terrace a raised level to the northeast outside of the tower, and left a passage 2.30 m. wide between it and the analemma.

The arrangement suggests a stair tower to give access to the colonnade around the back of the cavea, and from it to the rows of seats of the upper maenianum. By beginning a flight of stairs at the south angle of the tower and moving up in a counter-clockwise direction, 40 risers of about 16 cm. each, which is normal in the ring corridor, give the necessary height from the presumable tower floor to the level of the colonnade (see restored plan, fig. 4). With the normal run, only four flights of steps are needed to reach

Fig. 13. Remains of stair tower. Buttress B.5 at right.

the south angle once more, and here there would have been a door opening into the colonnade. There is no evidence for a doorway at the lower level through B.4 corresponding to that in B.5, but it has been suggested on the plan since access from the south would have been desirable.

Entrance "O," which differs in technique from Entrances 1–4 was most probably cut when the stair tower was built. It is only 0.80 m. wide as against 1.40 m. and is, of course, crowded against Buttress B.4. It would, however, have been most useful to provide a direct means of reaching the stair from the ring corridor, especially if traffic in Entrance 1 were heavy. As noted above, the buttress system is clearly an afterthought, though in all probability closely allied in date with the period of the enlargement. It would be highly natural for the stair arrangement to have been thought of at the same time and to have been

[15] Width of opening, 2.20 m.; thickness of buttress, 1.95 m.; projection from outer wall, 7.10 m.

[16] Heavily overbuilt by later work, and not cleared.

substituted for some other, not yet initiated, means of providing access to the upper level.

THE PARODOI

The east parodos (see Section, fig. 12) runs straight for the entire distance between the end of of the analemma and the orchestra. Some 16.50 m. of its original north wall is preserved, in places to a height of no less than seven courses. There is a socle which projects about 0.05 m. from the face of the wall, and the courses are bonded with the angle of the inner wall of the ring corridor in such a way as to assure their contemporaneity. Though the height of the courses varies from 0.58 m. to 0.26 m., the wall is not built of alternately high and low ranges of blocks. Twelve meters from the angle is a block whose upper surface is worked to a slope of 25°; this indicates that here the vault over the parodos slanted downward to fit below the rows of seats above it. There is nothing to show where the vaulting stopped or how it was related at the east end to the vault over the corridor. Where the paving slabs of the parodos have been taken up it can be seen that the socle is bedded securely on the rock.

The south wall has a similar socle and a thickness of 1.70 m. Most of the orthostate course immediately above the socle has been plundered, leaving a single block at the east end and a section of full thickness some 6.00 m. long farther west. It can be seen here that the wall consisted of three thicknesses of blocks.[17] No clamps or dowels were used, but there are pryholes for the course above. The south wall ended at the line where, later on, the barrier to the arena was established.

At present, the north wall at its western end shows where it was pieced out, after the arena was suppressed, so as to reach the edge of the reconditioned orchestra. The work is rough and includes a re-used pilaster base. The westernmost two or three meters of original wall had, of course, been cut away when the arena was established. Actually, the present north wall of the parodos is merely a revetment, slightly over 0.50 m. thick, for an earlier parodos wall built in pseudo-isodomic style as a facing for about 1.25 m. of well-laid rubble against which was packed the stone and rubble fill that supported the seats. It is important to observe that at least two seat blocks of the type used in the cavea have been re-used in the earlier construction, indicating either (1) a repair, or, more probably, (2) the fact that the cavea was curtailed when the earlier parodos wall was built. This significance of observation will be further considered below.

There is no evidence to show whether the first Roman parodos was covered or open, but most probably it was not vaulted. Although, conceivably, the south walls (if they ever existed) of the parodoi of the early Roman period might have been removed entirely, and then replaced by the later construction, some indication of that fact would almost surely be evident.

The paving is in part contemporary with the enlargement of the theater, but in part it is repaired. A drain, 0.40 m. wide and 0.40 m. deep, runs from the line of the arena barrier eastward, under the sill of the eastern doorway, and then curves to the southeast. That this drain served during the period of the arena is quite certain, but it also served the preceding phase of the building. We have no indication of the Roman orchestra level prior to the arena, but the pavement levels of the parodoi show that it must have been practically where it was re-established in the post arena period.

As has been noted above, the east parodos floor slopes gently down (0.43 m.) from west to east. To dispose of any water on this surface, a hole was cut in the slabs just over the drain, a little way inside the threshold of the east door. Repairs have left only a portion of the slightly chamfered lip of the hole in an original block.[18]

When, in the rehabilitation, the paving of the parodos was renewed at its west end, a large number of voussoir blocks were employed. They measure generally 0.52 m. in height and length and some 0.30 m. on the intrados; they come from an arch with a radius of about 3.30 m. No arch of such span could have existed in the theater unless it were a segmental one.

One of these blocks (fig. 14) was carefully placed against the truncated west end of the drain, which seems to have been abandoned in the rehabilitation save for its eastern extension

[17] Midway along the south wall, where orthostates are missing, two shallow drainage cuttings suggest an opening into the parodos from the south.

[18] That the floor of the Roman parodos could never have been any lower than it is at present is proved by the high level of the rock between the drain and the north wall. It comes very close to the under side of the paving, some blocks of which actually rest on it. Moreover, had the floor been lower, the stairs of the east end of the ring-passage would have extended into the parodos.

FIG. 14. West end of drain with blocking voussoir.

where it probably continued to function until the theater was given up.

An investigation below the floor of the east parodos at a point opposite the truncated end of the north wall revealed, at either side, cuttings in the rock some 80 cm. below floor level. They are roughly rectangular, about 16 to 20 cm. wide and long, and only about 6 cm. deep. Between them the rock has been roughly leveled off as though for a sill. The same arrangement is found in the west parodos and there are there traces of a vertical trimming in the rock, with a small hole for a fastening (fig. 15). These cuttings are clearly for the framework of a grille or wooden barrier which closed off the arena. That the floor of the parodos must always have been a good 70 cm. above that of the arena seems unquestionable, at least at the eastern side, so that either the barrier had a high, wooden sill, or there was, just behind it, when open, a high step. If the parodoi at this time were used only for the animals used in the *venationes*, or for the *venatores* themselves, this would not matter. Actually there was, when excavated, a wall built of re-used material (fig. 16) across the opening of the stairs in the east corridor; and it is barely possible that the stair was blocked at the time the theater was adapted for hunting purposes. This would, however, mean that the corridor remained blocked during the period of rehabilitation, and this seems improbable.

The west parodos is far less well preserved than the eastern one. All the superstructure of the outer (south) wall is missing, and only a few footing blocks remain. The same is true of the north wall save at its east end where, inside the line of the arena wall, there is a rough extension similar to that on the opposite side of the orchestra. The outer part of the parodos had a width of 3.10 m., some 20 cm. wider than the east parodos, but about 9.00 m. from the outer end the preserved paving indicates that it was brought down to normal width. If we restore a doorway in the south wall at this point, it will be almost symmetrically disposed with respect to the drain cuttings noted above on the surface of the socle of the east parodos, and hence we may suggest that there were openings into each parodos from the south. There are no traces of a paved approach to either of these proposed doorways, but there is, to be sure, nothing of the kind elsewhere. It is worth noting also that in the restored plan these suggested doors would lie beneath the line of the ends of the diazoma so that windows or openings at the upper level would come directly above them.

The level of the west parodos floor, as noted above, is higher at the outer end, −7.21 m. as

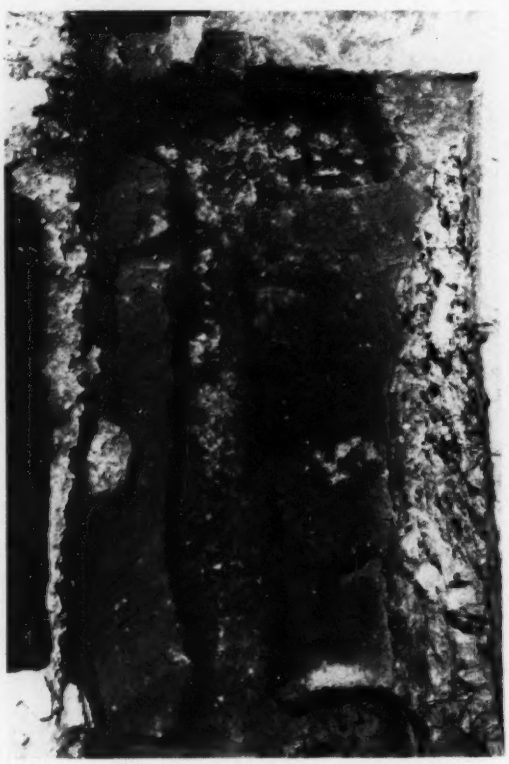


FIG. 15. Cuttings for arena barrier.

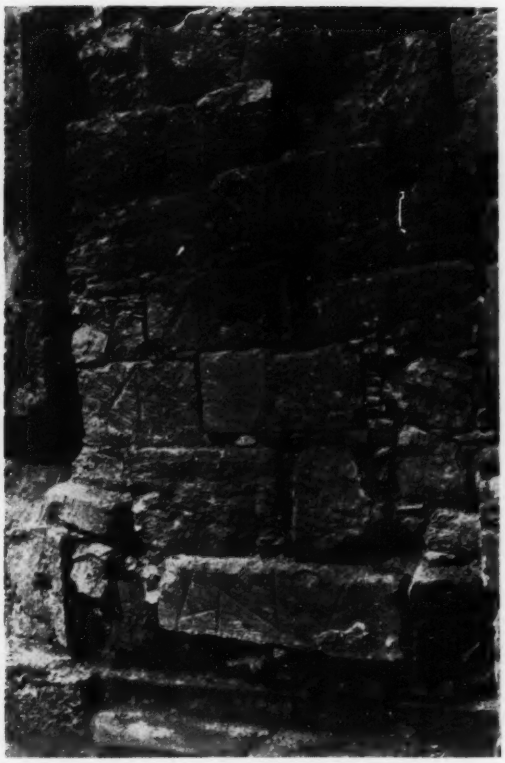


FIG. 16. Wall blocking southeast end of corridor.

against −8.65 m. for the east parodos. Three shallow steps, just by the angle of the corridor, bring the level down about 27 cm. and another step, eleven meters farther on, drops it 18 cm. more (fig. 12). From here on the floor slopes gently to −8.12 at the edge of the latest orchestra, which is itself about 13 cm. higher at the west than at the east.

Unfortunately the wall of the earlier Roman parodos, to which, as on the east, the later one was only a facing, has been plundered completely. The excavation plans do not give any indication of it, and a modern rubble facing has been erected so as to make further observation impossible. We shall return to these earlier parodos walls presently in connection with the pre-enlargement analemma.

In the period of the arena the floor of the west parodos for its last few meters was lower than it is now. In excavating the area around the arena gate a very hard-packed strosis of clay and sand, some ten to twelve centimeters thick, overlay the rock both within and without the arena barrier sill. How far westward this floor extended, it is not posible to say, but it may have gone to the foot of three or four steps which would have begun between two and three meters outside of the barrier. Underlying the parodos pavement still farther west may be seen the *back* of a wall or footing which does not have the same orientation as the parodos but lies very slightly more southwest-northeast. Its purpose is unclear and its date relative to the enlarged parodos uncertain. It may belong to the same period of construction and have been built against the footings of the south wall. The imprint of a now missing course of blocks remains in the cement that was filled in between them and the back of this wall. Towards its eastern end, however, it appears to be quite independent of the parodos footings, and hence may well antedate them. Possibly this small wall was a sort of terrace or curbing to retain the earth filling of the floor of the earlier parodos.

THE VOMITORIA AND CAVEA

Five passages (vomitoria) led from the corridor to the diazoma (figs. 2, 4). They are uniformly five meters long and 1.65 m. wide. A glance at the plan will show that only two are symmetrically placed. The outer end of No. III lies nearly two meters west of the central axis of the cavea. Nos. II and IV lie equidistant from the axis, about 15.50 m. to either side. Number I is relatively close to No. II but No. V is a good 10.00 mt. away from No. IV. It will be also noted that only two of these vomitoria, Nos. II and IV, are truly radial to the theater circle. The fact may be of significance, considering that they are symmetrically placed with reference to the axis, to show that there had been entrances at these points to the smaller, earlier theater.

Steps were provided in each vomitorium to relate the levels of the corridor with the diazoma. At the east, Vomitorium No. I had ten (fig. 17). Vomitorium No. III had three. The vomitoria are faced on either side with irregular ashlar in large blocks, some of them re-used material. The ceilings of these passages would have been barrel vaulted save just at the entrance to the diazoma. An interesting observation with respect to the plan is that only in one case (No. V) does the entrance from outside the building lie even partially opposite the entrance to a vomitorium. All the others are offset. One explanation may lie in the

FIG. 17. Steps in Vomitorium I.

fact that the builders felt that the openings might weaken the tunnel vault over the passage and avoided placing two weak points directly opposite each other.

Another possibility is that the inner ring wall was the first to be constructed and that when it came to the outer wall the placing of the entrances was dictated by convenience of approach from the exterior. We do not know the exact location of Entrance 4, but if it opened off the landing at the top of the outside western stairs it could at most have overlapped the opening into Vomitorium No. V by only half its width.

A diazoma, 1.90 m. wide, encircled the cavea two-thirds of the way up.[19] None of its paving survives. On the outside is the socle and some of the parapet of the upper maenianum; toward the inside is an opus incertum foundation *ca.* 0.70 m. thick, solidly built and strengthened at intervals of two to two and a half meters by roughly squared blocks set into it. This foundation may have been intended merely to strengthen the inner edge of the diazoma, but, more probably it served as the foundation of the podium for the seats of an upper maenianum, in the first Roman period. Still a third possibility is that it may have carried the stylobate of a colonnade which could have sheltered the walk around the back of the cavea in the period before the enlargement. The strengthening blocks, were they evenly spaced, would make this a plausible solution, but their spacing is quite irregular. For a continuous stylobate, however, of whose joints columns took no notice, this would not be mandatory, so that such a colonnade is not ruled out. It would, however, have had a clear width of about 3.75 m. which, for a relatively small theater, might seem excessive, but it may be remembered that the nature of the terrain did not permit of a colonnade or peristyle behind the scene building. Thus a wide promenade might have been provided above the cavea.[20] In any case this particular colonnade, if it once existed, did not survive the enlarging of the theater.

The podium, above which rose the seats of the upper maenianum, consisted of a socle, a die with molded base, and a capping course, also with moldings. The socle and the preserved course of the orthostate above it add up to a total height of about 0.75 m. The capping course is 0.35 m. high. A total of 1.10 m., however, would make it impossible to have the ceilings of the vomitoria extend to the podium, and a series of isolated sectors in the lower two or three rows of the upper maenianum seems unlikely. It would appear better, therefore, to restore the height of the podium to something over two meters, as indicated in the restored section.

There is room above the podium for a gangway and only six rows of seats if, as is usual, we are to restore a colonnaded walk at the back of the newly enlarged cavea. If the stair tower is correctly interpreted such a colonnade is certain. There are, moreover, a quantity of plain limestone column drums (but no capitals) which could have belonged to such a feature.

There are no clearly marked steps giving access

[19] The effective width was probably reduced to about 1.40 m. if a row of proedria occupied the top step, as, for example, at Sagalassos (Lanckoronski, Karl, *Städte Pamphyliens und Pisidiens* 2: 154, fig. 129, Vienna, 1892).

[20] The suggestion, made by Mr. DeCoursey Fales, who excavated the theater, is possible but relatively improbable.

from the diazoma to the upper maenianum. Either there were none and the upper seats were reached solely from the tower, and possibly from special steps at the ends of the diazoma where it is no longer preserved, or we must interpret some irregular cuttings and construction that occur between Vomitoria IV and III, and between III and II, as the narrow steps necessary to reach the top of the podium.[21] Figure 18 shows the existing situation. The irregularity of construction, however, suggests a very late, makeshift expedient, probably from the final period.

No seat blocks of the upper section remain in place, and relatively few in the lower section of the cavea. All the blocks which are in place occur in the first few rows; the great majority are those of the period of rehabilitation, after the arena (fig. 19). Many are very rough and almost unshaped; some, which may have been borrowed from higher up, seem to be of sufficiently good workmanship to belong to the earlier periods of the theater. Some still retain a portion of the coat of hard, yellowish stucco over a gravel cement base with which they were once covered. This coating is, presumably, not of the first period, but belongs in all probability to one of the rebuildings. The average height of the seats is between 0.35 and 0.36 m. and as nearly as can be calculated the run from the nose of one row to that of the next would have been 0.65 m. Each row is cut back below the nose on an angle of from 67° to 70°, and the nosing itself, some 9 or 10 cm. high, is also sloped back a little toward the bottom. The blocks are laid with their long dimension radial to the orchestra. Their width is normally 0.55 m.

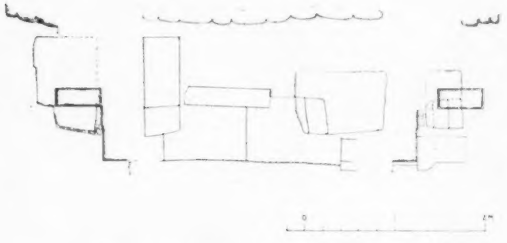


FIG. 18. Details of diazoma parapet. Plan. Sections at left and right.

[21] The theater and the stadium at Delphi both show how such a height could be surmounted with very narrow steep steps. On the other hand some Asia Minor theaters, as Termessos, and Sagalassos, show no access from the diazoma to the upper rows of seats (Lanckoronski, *op. cit.*, pls. 10, 26).

FIG. 19. Seat blocks in position.

A few lines of rock cutting for bedding the seats appear near the center line of the cavea (figs. 2, 6) and in other places the lines may be roughly traced by the imprint left on the fill below the seats. No regular seat foundations were provided, and in the course of time the seats have settled badly out of line. In some locations the fill was stiffened by rubble walls built of small stones, but they bear very little formal relation to the plan. One, which extends to a depth of nearly five meters, occurs in the western part of the cavea. There is another some six meters east of the axis. Still one more was noted by the excavators, running radially towards Vomitorium I, and a fourth extends diagonally from the upper limit of the last mentioned wall toward the higher part of the early Roman parodos backing at the southeast.

Stairs divided the cavea into five cunei.[22] The existing steps all belong to the post arena period

[22] Five cunei (κέρκιδες) suggest at once a Greek and Hellenistic layout, the principle being that save with rare exceptions, e.g., Epidauros, Corinth, Assos, it is the rule not to have a stairway on the axial line (Bieber, Margarete, *The history of the Greek and Roman theater*, fig. 315, Princeton University Press, 1939). Theaters of purely Roman origin, on the other hand, e.g. Orange (*ibid.*, fig. 467), Timgad (*ibid.*, fig. 470), Dugga (*ibid.*, fig. 473), Sabratha, Merida, Biskra—all have an axial stair. The theater at Soli, purely Roman, also has an axial stair and there are six cunei. (*Swedish Cyprus Expedition* **3**: 566, plan 40). Since the arena refuge, and the tribune above it, could have destroyed an axial stair, we must point to the fact that the spacing of the existing stairs precludes one *unless* there were intermediate stairs abolished in the late period. But to have five more sets of stairs in a relatively small theater would be awkward, and certainly unnecessary.

Priene, with an orchestra radius of over 9 meters, has but five κέρκιδες; Segesta, with a radius of 8.40 m. (very close to the 8.60 of Kourion), also has but five.

and are irregular and hardly ever follow a truly radial line. The width of each flight is 0.70 m. Presumably these late, re-established steps prolonged the lines of the earlier ones, which survived above the arena wall.

Thus far we have been concerned mainly with the cavea in its later periods, after the theater was enlarged. There is good evidence, however, for an earlier period, or periods, embedded as it were in the mass of later masonry, and here we can trace the original outer circle of the theater. The line of the early analemma begins near the southeast corner about two meters north of the east parodos and may be traced at intervals to a point midway between Vomitoria IV and V. The construction is pseudo-isodomic, orthostate and belt courses, respectively 0.52 m. and 0.25 m. high. The outer half of each belt course rests on an orthostate; for the inner half, a low bedding course is provided, set in the dense rubble.

The finish of the outer surface of the blocks is distinctive. They have V-section joints; the face gives the effect of being slightly pulvinated, and the surface is deeply picked. The resemblance to the work on a Hellenistic tomb, number 8 at Ayios Ermoyennis, is very close.[23] Beyond the point halfway between the 4th and 5th Vomitorium, the style changes, although the same circle is kept except that, as far as Vomitorium No. V, the wall tends to run in almost straight instead of truly curved sections. Here the pseudo-isodomic work ceases and the construction is irregular. It consists of uncoursed ashlar with a certain amount of opus incertum and should belong to the early Roman period.

The final section of this wall, south of Vomitorium V, presents several problems. It is built of uncoursed ashlar and opus incertum, very solidly mortared. The three lower courses of about the last four meters, before the wall is broken away, are entirely of ashlar, and consist of two belt courses with an orthostate course between. The blocks show a very hard, rosy cement with fine, pale grit in the joints, but it is difficult to tell how much of this is original with the wall and how much is due to the fact that when the later, inner wall of the ring passage was built mortar was chinked between the two walls. The impression is, however, that the earlier wall was laid with a certain amount of fine cement. At least one re-used block, the last in the orthostate series to the south, may be seen. It has a drafted edge, cut away in part on the lower side when it was fitted on to the course below.

Higher up in this wall, 4.50 m. south of Vomitorium V, are three courses of large blocks laid so as to form a vertical joint at their south ends (fig. 20). There seems to be no reasonable explanation for this, as far as a normal theater plan is concerned, but the feature may be associated with some adjustment in the course of the construction of this section.

When the theater was excavated, a straight wall, parallel to the north-south axis of the building, was partially uncovered, a little more than three meters inside the line of the west, early analemma (Q, fig. 2). In 1954 it was possible to sink a trench on the west side of this wall to a depth of more than three meters, without, however, reaching bottom. The wall, Q, proved to be pseudo-isodomic with smooth-faced blocks (fig. 21). Ten courses were uncovered. The orthostates are quite uniformly 0.52 m. high; the belt courses vary from 0.24 m. to 0.27 m. Toward the bottom, the last four courses, especially toward the south, are badly weathered and pitted. That the entire wall was exposed for a considerable period is certain, and the greater corrosion near the bottom is presumably explained by the fact that these particular blocks came from a softer quarry layer. The highest preserved course is at level − 2.09. To the east there is rubble, packed solidly against the wall, and it is clear that the packing must have been laid coincidentally with the courses, a form of construction like that noted in other parts of the early analemma.

That this wall once extended still further south is proved by the fact that in the original excava-

FIG. 20. View from the west showing wall built within the inner wall of the corridor.

[23] See above, note 9.

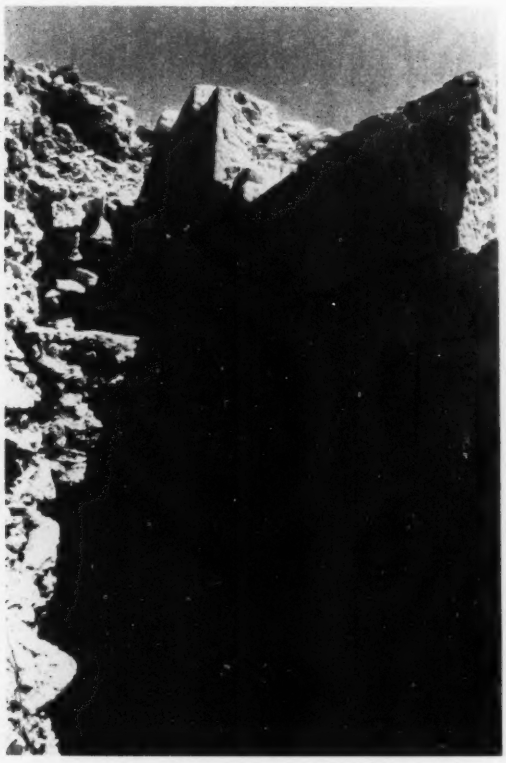


FIG. 21. Wall Q from the southwest.

tion the ends of two blocks were observed protruding through the heavy packing that lay behind the (vanished) face of the north wall of the *early* parodos.

The northern continuation of wall Q can, unfortunately, not be traced without pulling out great quantities of the rubble packing and debris which overlie it.[24]

Obviously this wall antedates the early analemma to the west, and, in excavating the trench alongside, it was evident that, as the outer wall rose, the fill between the two was packed in by building very rough spines of rubble a short distance apart and then filling in with more broken stone. When the fill and the outer wall had reached a level of −3.09, a trampled layer of earth and chips shows where work on the next higher section of the outer wall was begun. All the sherds found both above and below the working floor were of the Hellenistic period, save for a few in the upper level which could be early Roman.

There is, projecting through the lowest part of the early analemma, 5.00 m. north of the west parodos, a short spur of two blocks against or over which the analemma courses run. Its purpose is unclear. It may have formed part of a terrace, and for a time it seemed to indicate a jog or indentation in the Hellenistic analemma. But it is probable that wall Q extended farther north, past the line of the spur.

If we recall the vertical joint formed by the large blocks in the upper part of the early analemma, the suggestion may be made that they are only the result of a piece-meal system of building when this corner of the theater was filled out. But they also suggest that somewhere below them there may exist, buried in later work, a westward return of wall Q, and that when first laid out this part of the cavea had been indented because of some building near the southwest corner. Whatever it may have been, the building remains hypothetical, for no traces of it can be recognized in or under the mass of the second Roman period. The short spur wall suggests an unusual condition.

The difference in surface treatment between the smooth finish of wall Q and the pulvinated, picked blocks of the early analemma elsewhere in the theater (north and east) might indicate two different periods of building, but this same variation is also noticeable in the tomb at Ayios Ermoyennis. If we stipulate two periods the most obvious solution is that the original, full curve of the Hellenistic period was cut into at the southwest for an unknown reason, and wall Q erected. Possibly there had been a collapse at this point. The three lowest courses on the full curve, near its southwest end, beyond the spur wall, could just possibly belong to the original building. Some time after wall Q was built, and probably in the first century, as shown by the evidence of the sherds, the full circle was restored, solidly enough, but certainly not with the careful facing, as shown by the opus incertum, that one might expect.

An alternate suggestion is that this re-establishment of the full curve immediately preceded the enlargement and was made so as to enable work on the cavea to proceed while the outer ring-passage was being erected. This renewed or filled-out curve would, incidentally, have acted

[24] This was not practicable in the summer of 1954.

as a guide to the masons working on the corridor.[25]

THE ORCHESTRA

The entire orchestra (figs. 2, 4, 5 and 22) as now preserved belongs to the post-arena period. The radius to the ring of blocks that form its edge is 7.20 m., and to the lowest row of seats, 8.60 m. The area is now paved with a layer of broken stone mixed with a considerable amount of disintegrated mortar, which presumably served as the bed for a floor of marble slabs. The edging blocks are irregularly laid, of varying sizes, and define a pavement of blocks or slabs which extend to the base of the seats. There is no gutter, or any provision for drainage save the pitch of the floor which is downward to the east parodos. On the south, the floor reaches the foundations of the late pulpitum, itself built of squared blocks solidly mortared together. Only two blocks of the course which once showed above the floor remain; these are at the west end. Below the level of the bedding for the orchestra floor is a fill generally consisting of two layers of broken stone, with few coarse pottery fragments, and in places a great deal of sand. Roughly 0.70 m. below the late orchestra level is another layer ten to twelve centimeters deep, this time of clay and sand, without any sherds, overlying the native rock. The sand extends, or once extended, to the limits of the rock-hewn arena wall, on a radius of 10.80 m. The foundations of the stone edging of the late orchestra, as well as those of the pulpitum, were let down into this layer so as to rest on the rock, and remains of this same arena floor were observed in the area between the pulpitum and the scaenae frons. As noted in connection with the west parodos, the same floor of hard-packed clay and sand reached for an indeterminate distance beyond the sill of the west barrier of the arena. The layers observed between the rubble floor and the original arena floor were probably caused by raking the sand toward the center of the arena when the circle of the late theater orchestra was re-established. It is also likely that the arena level rose somewhat, especially toward the center, during the period of its use.

As in a number of other theaters,[26] the right-angled corners formed by the scaenae frons and the prolongation of the arena walls south of the parodoi were "faired out" by curved walls. These are well preserved and show remains of painted stucco in broad, white panels separated by purplish brown to black vertical strips. The panels are normally 1.20 m. wide; the strips 0.33 m. The "fairing" walls are built for the most part of squared blocks chinked with small stones and mortar.

The rock under the arena floor was quite carefully leveled and in places patched with lime-cement.[27] The presence of hollows or even large caves not far below the arena level makes this precaution a reasonable one, lest with rain a series of soggy or muddy spots might form, or in the case of an actual crack of any size the water would, in seeping down, pull the sand floor along with it.

In the various trials that were made no gutter of any period was found, and no certain trace of any orchestra level antedating the arena. Were it not for ample evidence to the contrary, it would be tempting to say that the theater was from the first a *theatrum venationum*, but this positively cannot have been the case. It is clear that whatever orchestras preceded the arena they were entirely obliterated by it, but we must return to this question in considering the theater of the Hellenistic period, since it is possible that its orchestra may have lain at about the level of the arena floor.

One other important arena feature remains to be considered. On the central axis is a vaulted refuge 1.60 m. wide by 2.20 m. long (figs. 2, 6, 23).[28] Its floor is at the arena level, but a thin barrier wall 0.60 m. high has been built across the door. It is not so high, however, that it

[25] The irregular course of the outer wall of the corridor starting off as it does on a line diverging from the inner wall, and then being bent sharply eastward so as to meet the correctly placed curve of the outer wall, shows clearly that there was some obstacle to completing the curve of the enlargement in a proper manner, and that the masons were working, for a time at least, without proper direction. The shoddy foundations on the east part of the analemma, with the enforced addition of unsightly buttresses, is added proof that the work, for a time at least, lacked proper supervision.

[26] As at Corinth (*Corinth* **2**: 85), Tyndaris (Dinsmoor, W. B., *The architecture of Ancient Greece*, 315, London, Batsford, 1950).

[27] *Cf.* Soli, (*Swedish Cyprus Expedition* **3**: 559) where lime cement was used for the orchestra floor on a substructure of rubble, pebbles and fragments of terracotta.

[28] Refuges are found in nearly all theaters adapted for "hunting." *Cf. Corinth* **2**: 84, note 2; Einar Dyggve (*Recherches à Salone* **2**: 107, note 1, Copenhagen, 1933) gives a long list. *Cf.* also Saria, Balduin, Das Theater von Stobi, *Arch. Anzeiger* **53**: 98–103, Berlin, 1938.

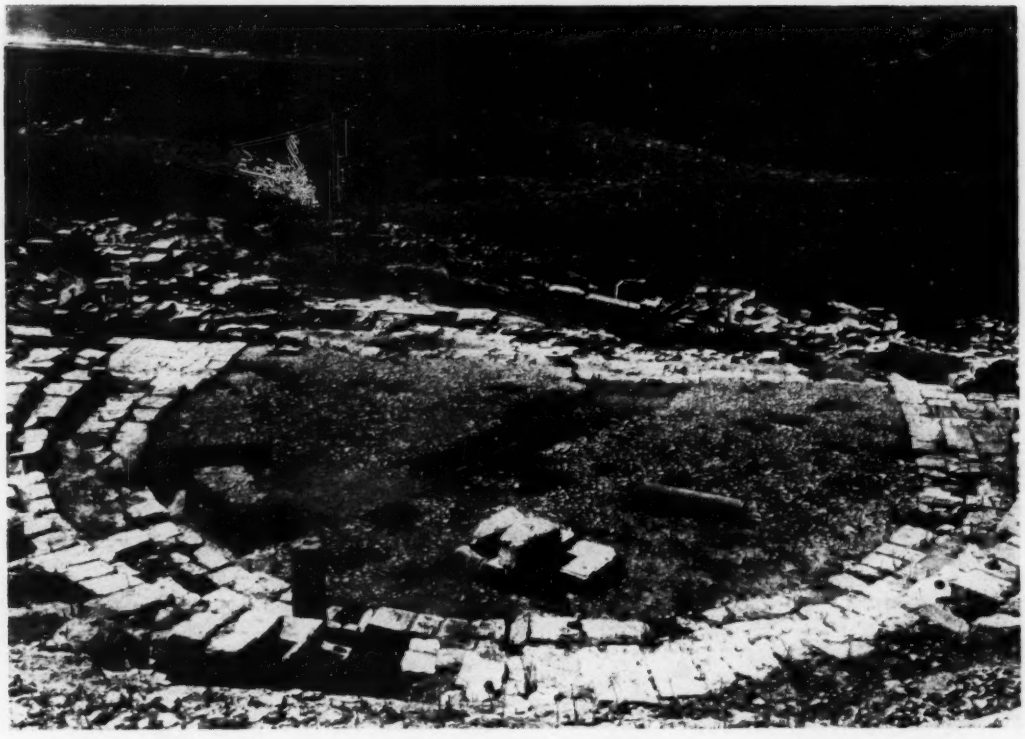


FIG. 22. The orchestra.

cannot be easily stepped over. The lower part of the sides and end of the chamber are cut in the rock. Above that the side walls are of ashlar and the vault is neatly turned with long voussoirs. The back wall is of rubble carefully laid but divided down the middle by a vertical joint. There seems to be no good explanation for this.

Just east of the refuge two rubble walls at right angles form another chamber 1.70 m. by 2.20 m. less whatever thickness was given to its front wall, which is now gone. The floor is about a meter higher than that of the vaulted refuge, and there seems to have been no communication between the two; it is hard to explain the purpose of this room. It might have served as an additional refuge, built after the vault, for the rear wall abuts against the extrados of the vault, but the connection between the two is so loose as to suggest that the rear wall was cut into when the vault was built and the gap thus made rather carelessly filled with stones.

Over the refuge was a tribune, *ca.* 3.50 by 2.50 m. (inside dimensions). The socle for the back wall and the start of the sides is still in place. There was a secondary, smaller exedra behind it, 0.70 m. higher up. The floor of the tribune was at a level − 6.00 m. or 3.00 m. above the floor of the arena. With the addition of a

FIG. 23. Refuge belonging to arena period.

parapet the wall protecting the spectators would have measured some 3.70 m. in height.[29]

THE STAGE BUILDING

The stage building (figs. 2, 4, 5, 6, 22, 24) has suffered not only from successive periods of remodeling, but also from earthquakes and extensive pillage. No superstructure, save a few blocks at the east end, remains to assist in a restoration. Only a relatively small number of useful architectural fragments can be separated out from the considerable mass of fallen blocks.[30] The general outline of the stage building is easily made out. It had, in its main period, an overall length of 31.20 m.[31] and extended southward 7.00 m. from the face of the outer walls of the parodoi. Four principal lines of foundation may be distinguished (fig. 2).

1. Wall A-A, the front of the pulpitum of the post-arena theater. As noted above, this rests on bedrock, has a mean thickness of 0.60 m. and is built of squared blocks chinked in places with small stones and strongly cemented together. The two remaining blocks of the socle, near the west end, show that there were generally four courses. This wall abuts at the east on the end of the south wall of the parodos, and sets forward from its inner face about 30 cm. Whether the present end of the parodos wall was the original is uncertain, for it has been entirely buried by a mass of rubble put in with the "fairing" wall of the arena, but in all probability the parados wall did not extend farther in than at present. Behind wall A-A there is no sign of a curtain trench.[32]

FIG. 24. Stage building, looking east.

2. South of A-A, about 2.60 m., is a clear line of demarcation where the level drops *ca.* 50 to 60 cm. The area between the line and the pulpitum wall is mostly bedrock, was once covered by the arena floor, and shows a line of foundations B-B. These consist of groupings of squared, re-used blocks, pieced out with irregular stones which are either let into the rock or are used to level out natural hollows. All the inserts are below the level of the sand-clay arena floor, and hence antedate it. The excavators' notes state clearly that the arena floor had to be cleared away to expose them. These groups of squared blocks appear to form a rhythmic, fairly symmetrical pattern, and suggest columnar projections from the face of the scaenae frons, but the symmetry with respect to the central axis of the theater is not exact, and it is doubtful that they can be regarded as footings for the elements of a scaenae frons. One item of importance should be noted here. Under the foot of the western "fairing"

[29] Compare this (12'2") with 12 feet at Corinth, 11 feet at Tyndaris (Dinsmoor, W. B., *op. cit.*, 318).

[30] A full examination of these during the summer of 1954 was rendered impracticable by the fact that in clearing the building they had been stacked in a narrow area south of the excavations, on the edge of a high modern retaining wall.

[31] Vitruvius, V. vi. 6: "The length of the stage (scaena) must be twice the diameter of the orchestra." The diameter of the late orchestra, to the first row of seats, is actually 17.00 m.; to the inner edge of the stone curb it is 14.10. Neither of these dimensions, doubled, will exactly equal 31.20 m. But we are dealing here with work of two different periods, and we have no means of arriving at a precise measurement for the orchestra of the second century theater. Working backwards, $31.20 \div 2 = 15.60$. If we take this from 17.00 we have 1.40, or a step of 0.70 m. in width at the base of the lowest row of seats. Moreover, we should allow for a shallow step, at least at the mouth of the east Parodos, to prevent water from running down the parodos pavement, and make sure that it went out by the drain channel. The discussion is, perhaps, academic, since exact correspondence to Vitruvian rule is rarely found.

[32] Curtain trenches seem not to have been used in the late period, after the second century A.D. See *Corinth* **2**: 82, note 44.

wall is the end of a block, set perpendicular to the line of the stage (shown just below the letter A, on fig. 2); it projects some 20 cm. beyond the arena base of the "fairing" wall, and is low enough to have been covered by the sand floor so that it evidently had nothing to do with the arena period. Together with the other blocks of B-B, it shows conclusively that the arena could not have been the original form of the theater, and it suggests, further, that there was an orchestra at a low level in an early period.

3. Foundation C-C, *ca.* 3.10 m. wide, is marked on the north side by a line, including a break in level, where remains of mortar parged against the face of the foundation shows where the blocks were torn away. The back, or south side, of this foundation is represented by the lower portion of its south face, consisting of ashlar blocks, rubble, and mortar. It is not properly a wall, in that it does not have two faces, and must be considered merely as the lowest part of a massive, solid foundation. At the east, the area once covered by this foundation runs against the remains of a line of blocks which extend north-south to the parodos wall. Beyond this point more foundations, partly rubble concrete, partly stone blocks, are preserved. At the west end there is a confusion of blocks (some re-used), rubble, mortar and, at a distance of 10.80 m. from the axis, a well-preserved angle (R) of pseudo-isodomic masonry of an earlier period (fig. 25). The corner is, curiously, not a right angle, but slightly obtuse (93°), and it is almost symmetrically placed with respect to the foundation blocks at (S), whose

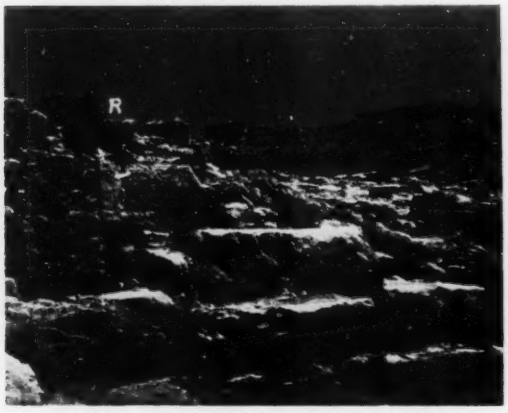


FIG. 25. Wall C-C with angle of earlier stage building at R.

FIG. 26. Rear wall of stage building, D-D. At lower right, the shops built against it.

line also is out of perpendicular to the stage front. More will be said about this later in considering earlier periods of the stage building. For the moment it is enough to note that we have here the impression of an earlier building around which an enlargement has been wrapped, just as in the case of the cavea.

The southernmost wall, D-D, of the stage complex, running for a total length of 31.20 m. is, today, its most impressive portion (fig. 26). For a length of 17 m., throughout its middle portion it extends down into a deep rock cutting. It is strongly built of large, squared blocks set with thin, hard mortar. Eight full courses, at the deepest end to the east, are preserved, and the mean thickness of the wall where it can be measured is about 80 cm. There is a setback of varying width above this, for the faces of the upper and the lower parts are not quite parallel. The horizontal lines of the courses sag slightly toward the center. Immediately behind (north of) a portion of this lower wall, is rock face, broken by a complicated series of natural caverns which have been considerably modified by artificial cutting. Supporting walls and stone piers or pillars were liberally introduced to insure the stability of the rock above. The west end of the upper wall appears to have collapsed at one time and to have been rebuilt, together with the solid foundation below it, with re-used material.

Against the back wall, at a low level, is a series of rooms, S.0–S.5, whose floor levels rise successively to the west, probably following the gradient of a street, still buried, to the south of them.[33]

[33] This street, which has not been uncovered, presumably led up into the city from the eastern gate.

In room S.2 are two openings in the wall. One leads into the series of caverns under the rock ledge (fig. 27). The other is merely a deep recess, through which a water channel emptied into the circular mouth of a cistern in the corner of the room. The arrangement may antedate the present west wall of Room S.2, however, since the wall in its present position puts the mouth of the well in an awkward angle.

Returning to the back wall, there is a curious change in its character toward the east in the section between Rooms T.1 and T.2. The large ashlar blocks come to an end and the wall is then built, in its lower part, with re-used pieces of a highly interesting pattern. No less than six sections of half-columns, with a deep tongue behind them, were laid transversely to the line of the wall (fig. 28). They are solidly bedded in a white gypsum mortar and leveled up with small stones. Below this layer the foundations are of squared blocks mixed with rubble, all well cemented. There is no perceptible break between this section and the ashlar further west, and both sections have had their inner faces and uneven angles parged with mortar, which was applied, as in numerous other cases in the theater, with the hand as a tool; the marks of the plasterer's fingers are frequently visible. The original purpose of these half columns will be discussed more fully elsewhere. Enough now to say that they suggest the supports of a high proskenion of the Hellenistic type.

Above this foundation the wall is built in opus incertum, with well-mortared joints on either face. At the far east end of the wall, at the angle of the building, we find again the same ashlar construction of blocks laid on edge, with backers, which

FIG. 27. Openings in lower part of wall D-D.

FIG. 28. Half-columns of Hellenistic proskenion built into wall D-D.

can be seen in the highest preserved course of the south wall toward its central portion. In spite of the variation in building methods it is difficult to postulate a repair as the reason for the difference. The western end of the building shows far more clearly what type of construction results from a repair. The outer face of the stage building at its east end is made of irregular ashlar, and would be contemporary with the south wall. It runs against the parodos foundation, but does not appear to bond into it. That there was an entrance in the angle, forming an entrance to the versura, is certain, but its original form is not preserved. In a late period the threshold was raised and steps were provided to lead up to it at the higher level. From the existing remains the door would appear to have been 1.40 m. wide. Six or seven blocks of superstructure, set on edge, remain in place and mark the north wall of a stair tower. One step is still in place and another was found close by and has been replaced. There is a well-squared block 0.60 by 1.20 m. marking the core about which the steps were disposed, and the stair itself, about 1.00 m. wide, wound upward in a clockwise direction. Square landings would have been provided at the angles. No actual doorway to the stairs is preserved, but a possible arrangement is shown on the restored plan. As far as can be ascertained the spaces under the steps, in so far as the top of the foundations are preserved, are packed with rubble resembling the construction of the large stair tower at the northeast quadrant. Only a mass of foundations, which seems to have undergone much repair, is preserved at the southwest corner of the stage building. It would presumably have underlain a stair tower similar to the one already described.

The relationship, chronological and structural, of the walls and foundations to the east end of the building is complicated and can be interpreted in various ways. We refer to the following: Wall α the south side of the east end of the broad foundation C-C; Wall β about 0.50 cm. south of Wall α and not quite parallel to it; Room T.2, formed by Wall β and its southward return to Wall γ, (or the back wall of the scene building (D-D), which in turn forms the north side of Room T.1). This room, long and narrow, is bounded to the south by Wall δ, to the west by a wall now no longer preserved which rested on a shelf at the edge of the deep rock cutting above Room S.0, and to the east by Wall ϵ which continues southward and divides Rooms T.5 and T.4.

Wall α: the south face is covered with stucco which extends east into the gap between it and Wall β. There is a back-fill of earth and stones loosely thrown in between the two walls. Toward the top this fill becomes more solid. A terracotta pipe leads through Wall α, into the space between the walls, turns west, and is then broken away. It would seem, however, to have led to a drain just west of Room T.2. Wall β is built of rubble, laid to a good face on either side. The northwest angle is turned with squared blocks. The southern return of Wall β (forming the west wall of Room T.2) was cut when Wall D-D was built, (this particular section hereafter referred to as Wall γ) and there is a noticeable gap between the two, which surely would not have happened had Wall β and its return been built later.

The east side of Room T.2 consists of rubble facing built against the heavy foundation further east. It was laid after T.2 had been partly filled with earth, and its lower part is merely a loose stone fill thrown into a trench cut in the earth that partly filled Room T.2.

Wall γ has already been described, but it should be added here that, in cutting away a part of it to free one of the half columns, two pieces of limestone epistyle were found which correspond to fragments of an inscribed entablature which, as will be seen, may be ascribed to the middle of the first century A.D.

Wall ϵ, forming the east side of Rooms T.1 and T.5 runs at an angle against Wall γ, and appears, in its lower courses at least, to run beneath it. The upper part of Wall ϵ abuts against γ and should be either contemporary, or later. The west face of Wall ϵ was plastered, and the level of the plaster, which matches that on the south side of Wall γ extends down about 70 cm. below the top of the footing of Wall δ. This suggests that δ is later than γ and ϵ, but, on the other hand the orientation of δ, parallel to β, points to their being contemporary. The probability is that δ was rebuilt, along the lines of an orientation established *prior* to the enlargement of the theater, which would account for the fact that there is no apparent trace of attachment, on the north face of δ for the return of Wall β.

The sequence of this construction is reasonably clear, although the functions of some of the walls just discussed are not. Wall β and its return at the west of Room T.2 is surely earlier than the period of enlargement of the stage building. Since Wall δ is parallel to β, and their construction similar, this, too, should be earlier than the enlargement, and it is most probable that ϵ, in its lower part, also belongs to the same complex, which would thus have lain southeast of the corner of the earlier stage building and quite separate from it.

The plastered south face of Wall α (the eastern end of C-C) suggests that when it was built Wall β and the others were not in existence, and that when they were established the builders were not encouraged to build *against* the theater. The good north face of β is no reason to assume its being earlier than α, for the wall is not thick and could easily have been laid up by a mason working from the south side. Thus, as is very clear from the plan, this complex has no organic relation with the theater.

The enlargement resulted in the cutting of the west return of β, which presumably extended at first to meet δ. Wall γ was put in, extending across the lower part of ϵ which was rebuilt up against it, to form the east side of room T.1, later made into a reservoir paved with slabs of gypsum or else into a narrow area possibly giving access, over the gypsum flags, to a ramp leading up eastward.

Room T.2 was filled in with earth, and a part of this, along the east edge, was later dug out to be filled with stones, on which was laid a thickening of the west wall of the stair tower.[34]

Although they have no direct connection with the theater, Rooms T.4 and T.5 shows that they were in use, probably as cellars, as late as the

[34] It might be possible to see in this complex a hall similar, but in a poor way, to the halls which were sometimes provided at either end of Roman stage buildings, but if such was the case, the building shows only too clearly the highly provincial nature of the enterprise.

fifth century A.D. Coins ranging from Constantius II (A.D. 345–361) to Honorius (A.D. 433) were found on their floors, but there is no definite evidence as to when T.4 was first built. The east and north walls of Room T.4 are later than the west wall (ε). There is no plaster, such as runs through the junction where the north wall abuts Wall ε. They are built of smaller, irregular stones, and there is much use of tile and sherds for chinking. Both walls, however, are based on rock. Parallel to the north wall, about one meter away, a retaining wall built against a cut in the fill which ran against the east end of the stage building, formed an areaway or light-well for two windows in the north wall of the room.

WALLS EAST OF STAGE BUILDING

Two rubble walls running east-west abut against the east end of the stage building. Both are bedded on rock, as is also a thin, transverse wall connecting the two. Their function was probably to retain the fill at this end of the building. The northern one of the two would have supported a ramp or terrace approaching the versura; the other represents a broadening of the area and, as far as can be told, was essentially a part of the same building program. The function of the thin, transverse wall is not clear.

The most important item in this area is a rock cutting, P, (fig. 2) which follows a line running southeast-northwest just outside the foundations of the east parados. It seems clearly to have been made for a wall, and its location is such that it could have served for a retaining wall that formed the south side of a parodos in the Hellenistic period. Unluckily there is only a little more than two meters of the cutting to be seen, but it is significant that at rock level in the trench made at this point a coin of Ptolemy IX was found. The inward continuation of this line lies beneath the heavy Roman foundations, and at the west, where one would expect to find its counterpart, the critical area is solidly concealed by the later foundations.

The west end of the stage building is clearly marked by a foundation Z, which now forms one side of a U-shaped area. The west and south walls of the U rest on earth, but they correspond to the late constructions just outside the east versura.

The angle, R, of an earlier stage building, on Wall C-C, was preserved by being incorporated into the later foundations (fig. 25). Its present top is at −8.83 m., quite low enough to come well below any superstructure.

Against the west end of the foundations of the stage building is a rubble wall, which runs past them to the south and there formed one side of Room S.5. It is joined at an obtuse angle by another rubble wall, running northwest, and this in turn has still another running into it from the west. It is quite evident that these are retaining walls, adjusting the levels at the west end of the building. They may, later, also have served for rooms, as at the east, but they have not been fully explored.

SHOPS SOUTH OF STAGE BUILDING

A series of rooms, probably used for shops, was built against the heavy foundation D-D of the back of the stage building. The eastern side of Room S.0 is formed by a rock scarp. The

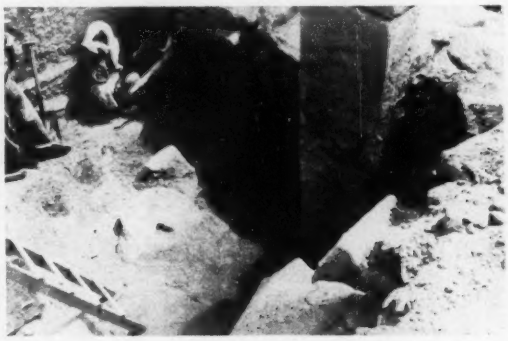


FIG. 29. Room S.1 from above.

rooms are divided by party walls consisting of squared blocks and rubble. From time to time various modifications took place; a niche was built in the wall between Rooms S.1, S.2, and a pavement of squared blocks laid in Room S.2. The line of the front (south) face of the shops has been only partially cleared, but it appears not to have been quite parallel to the back of the stage; it diverges from it slightly toward the west. In S.1, the jamb of the doorway is preserved to its full height and consists of two upright blocks with a smaller one between that bonds into the rubble wall (fig. 29).[35] Above the second upright block is a shallow cap block to receive the lintel.

[35] The same type of construction occurs in the Palaestra at the Sanctuary of Apollo Hylates at Kourion.

Room S.2 served as a watering place, hence its pavement and the well-cistern which it contains.

Rooms S.3, S.4, and S.5 are poorly preserved, and there is no special indication of their use.

These shops are contemporary with or slightly later than the reconstruction of the theater. That they continued to serve for a considerable time, probably until the destruction of the theater, is attested by coins found in their ruins. The latest, in Room S.1, occurring a little above floor level, is of Valentinian I (Valens), about A.D. 372. A similar coin was found on the floor of Room T.4, so that from the evidence the theater and the buildings adjacent to it were destroyed in the last half of the fourth century.

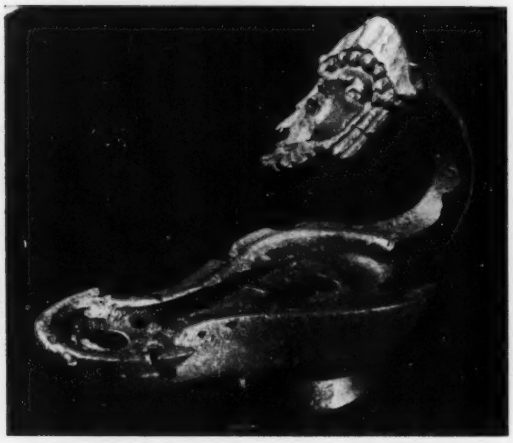


FIG. 30. Ephesos-type lamp from Room S.1.

The discovery in Room S.1, at a low level, of a handsome bronze lamp of the Ephesus type (fig. 30), datable to the first century, cannot be taken as a means of dating the shops. It was possibly found by the owner, and used to light his wares.

ROOMS NORTHWEST OF THEATER

A series of walls and foundations, largely of rubble masonry liberally chinked with pieces of brick and tile, was partially excavated to the northwest of the building outside the analemma. None save the wall Ω can be connected with the theater proper, and this wall, solid and built of re-used blocks, including a column drum, was most probably only a terrace wall against which the parapet flanking the outside stairs ended. Save for a well-built rubble foundation X, which is probably earlier than the enlargement of the theater, the other walls belong to the third or fourth centuries, and were part of the houses which flanked a street that seems to have run past the north side of the theater. The wall which runs diagonally and almost parallel to the outer curve of the analemma is, in its lower part, older than the south wall of Room W.2. Along its base, on the southeast, was a line of terracotta pipe which formed the continuation of a line observed just outside the analemma, between entrances 2 and 3. Since this line was cut by a later pipeline leading water into the upper part of the cavea, in the late period of the theater, it is likely that the diagonal wall served merely as a part of a fence between the theater and the area to the northwest.

WATER SUPPLY

One might suppose that the several caverns underneath the theater were employed as reservoirs, but this does not seem to be the case. Although there are in some places traces of stucco on the walls, no wells or shafts have been found that would serve for hauling up buckets.

The well in Room S.2 outside of, and below, the theater was fed through an opening cut in the wall just above it, but the water came without doubt from a pipe, of which traces could be seen in Rooms T.7, T.8, and again farther east between walls α and β. The inner side of the back wall, D-D, is altogether too rough and has too many chinks, to say nothing of an absence of stucco, to have retained water in the caverns below the stage. As far as can be seen (for they were not cleared in the excavations) the caverns (fig. 31) served as storage places, but only one entrance, now blocked, ever existed.[36]

Under the northeast quadrant are two large caverns, in part natural, in part artificially enlarged. Either or both could have been used at an early time as reservoirs, but neither shows any outlet which would lead water down to the orchestra level, for a *naumachia*, or water-mimes.[37]

The northernmost cavern, which we shall call the north cave, is the more interesting. It is reached by a passage with good ashlar walls which passes through the foundations of the

[36] Vitruvius, V, ix, 8, speaking of theaters says: "Praeterea in his operibus thesauri sunt civitatibus in necessariis rebus a moribus constitui."

[37] The late orchestra, in any case, shows no sign of a retaining wall for water, as at Athens, Corinth, etc.

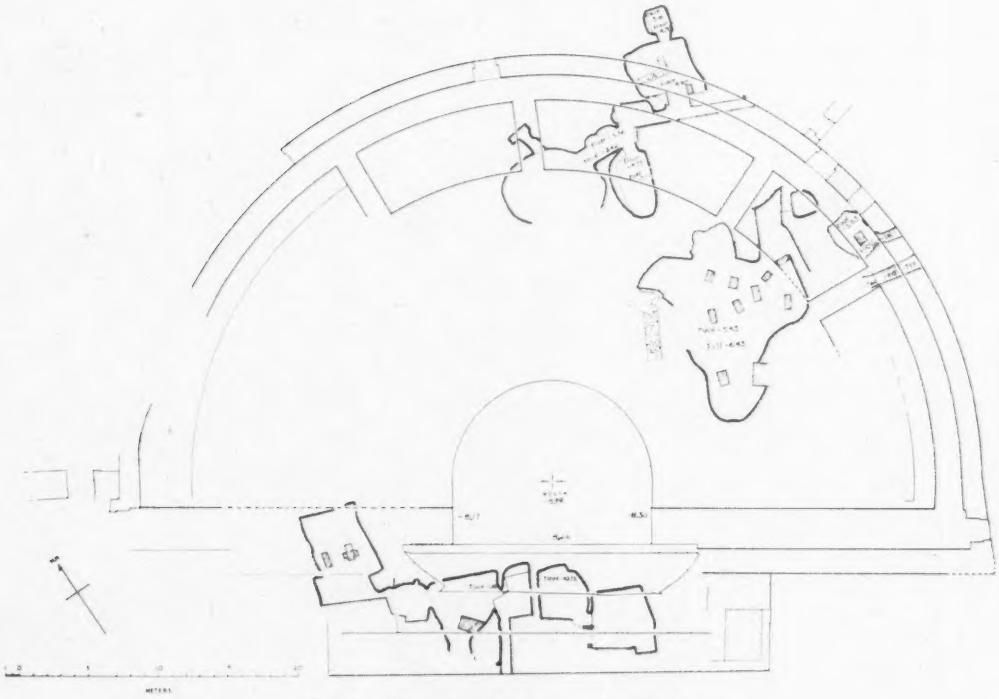


FIG. 31. Plan showing caves under theater.

Roman analemma and runs below the floor of the ring-corridor. On the right, as one enters, an opening gives access to a square, rock-cut chamber, out of which opens a smaller cell. Cuttings in the jambs of the opening between the two show there was once a door provided with a locking bar. The large, outer room had another cell built in its northwest corner, and this cell, too, was provided with a stout door. The use of these cells is entirely hypothetical—they may have served as prisons, they may have been places to keep animals used in the hunting-games. There is, farther down the passage at a place where it bends sharply left and then right, a third, roughly oval chamber. Finally, about twelve meters from the entrance, the passage opens into a large, round cave, out of which leads a small cul-de-sac, ending in a vertical shaft. The upper end of the shaft is covered by four large slabs laid on edge, with small gaps about 15 cm. wide between them. These probably served to support the line of the early Hellenistic analemma, and if so, indicate that the shaft, which was doubtless for drawing water at a time when the inner cavern formed a cistern, antedates the theater. Since the shaft, however, lies barely within the outer face of the analemma, there is also a chance that a recess was provided here and that the cavern may have been in use as a cistern until the period of the Roman enlargement.[48] It is quite clear that when the theater was enlarged, access to these caverns was maintained.

Just outside the theater, opposite the entrance to the northeast cavern, is a large, partly built, partly rock-cut, cistern, accessible only through a square manhole. It measures 6.40 m. across the bottom, and has a sinkage, about one meter square and 0.35 m. deep, in the bottom. It was filled to a height of 1.30 m. to 1.60 m. There is no connection between it and the passage, and from the fact that only first-century Roman jugs came from it, it seems that it was covered over and abandoned at the time the theater was enlarged.

The northeast cave, of very irregular shape, is part natural and part artificial. It has been consolidated at various places on its perimeter by

[48] Compare a similar provision in the east parodos of the theater at Corinth (*Corinth* 2: 51-53).

strong rubble walls, and at least nine stone piers have been inserted to support the rock ceiling. At present the only access is by crawling under a ledge half way up the cavea. There are also two small caves for which openings were left in the analemma foundations. One has its roof supported by a heavy stone pier; the other is more tunnel-like and may have once connected with the northeast cave, but the connection is now entirely lost. Both of these openings are at such a low level, that, without an areaway to retain the earth fill of the street skirting the analemma on this side, it seems unlikely that they could have been in use for any time after the enlargement. The openings show scarcely any sign of wear and the best explanation is that they were left during the construction as a means of access for placing supports under the cavea.

The northwest cistern, mentioned above, has not been cleared, but it seems to have been closely associated with the enlarged theater. The analemma jogs out (fig. 4) about 1.50 m. from the perimeter, so as to enclose a narrow passage leading to the mouth of the cistern which seems to have been fenced in by a thin wall, now no longer preserved. Unfortunately, the connection of the passage, parallel to the corridor, and the corridor itself have been badly plundered. The masonry, however, in so far as it is preserved, would permit the placing of a small door, which is further suggested by the presence of a much weathered block of a flat arch fallen nearby. Hence it is more than likely that the water from this cistern was carefully reserved for the use of the theater and accessible only from the ring corridor.

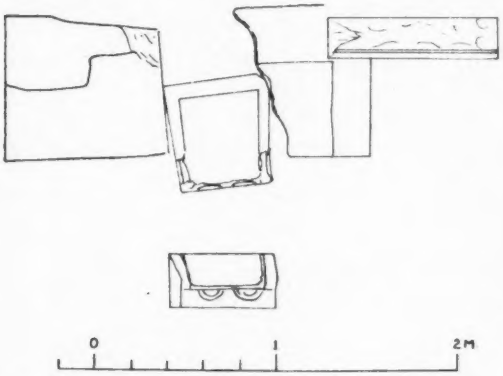


FIG. 32. Parapet and water distributor in diazoma. The upper drawing shows the plan, the lower, the elevation.

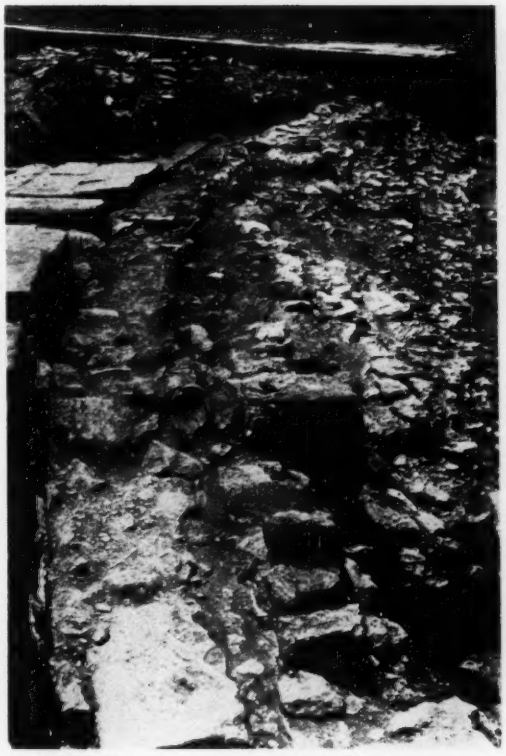


FIG. 33. Bedding for water pipes in diazoma.

At a relatively late date, probably when the theater was adapted for hunting, an additional water supply was provided. A line of terracotta pipes, leading down from the north, passes through the outer wall, between Entrances 2 and 3, and across the ring-corridor, to a distribution box set in the podium behind the diazoma. The siphon principle was used, for the entrance level of the pipe at the corridor was about 1.25 m. above the floor, and it was necessary to run the line down in a chase cut in the wall, across the floor of the corridor in a shallow trench, and once again, by means of a vertical chase, to reach the level of the distribution box (fig. 32).[39] From the box there led four pipes: two in front, one each to left and right. The line running east is partially preserved and can be traced past the mouth of Vomitorium I, whence the pipe turns down towards the lower part of the cavea (fig.

[39] A similar siphon system, using terracotta pipe, was pointed out to me by Mr. J. S. Last at the sanctuary of Apollo Hylates.

33). It is sufficient to show that at this time water was distributed to several points of the theater, probably a most welcome source of refreshment on a hot day!

The pipe line that brought the water into the theater cut through an earlier conduit which ran west, around the perimeter of the theater, passed over the northwest cistern, and can still be followed to a point in Room Ω A. There is at present no indication that it ever served the theater, but it is clear that the source which was tapped is the same as that used subsequently to feed the distribution box in the diazoma.

RESTORATION

THE FIRST THEATER (FIG. 5)

The restoration of the Hellenistic theater leaves several important questions unanswered, but the traces which have been noted above point definitely to its existence. They are as follows: (1) The analemma in the east and north quadrants. (2) The cutting for the east parodos. (3) The re-use of seat blocks in the early Roman parodos. (4) The half-columns suggesting a proskenion, built into the foundation of the Roman stage. (5) The pseudo-isodomic wall in the west part of the cavea. (6) The fill under the seats, where tested, which seems to contain no pottery that cannot be Hellenistic, save in such places as would have been tampered with later on.[40] (7) Numismatic evidence is not entirely conclusive, but the earliest coins found are Ptolemaic. One of Ptolemy IX came from the level of the rock, near the cutting for the East Parodos.

Assuming that these factors add up to a Hellenistic theater, what can be said of its plan? The first, most serious lack, is that of a recognizable skene. Successive remodeling seems to have obliterated all sure traces. The second and very important feature is the orchestra, and two questions arise: (1) What was its size? (2) What was its level? Possibly both can be answered. It does not appear logical for the arena builders to have lowered an earlier level to the extent they did by quarrying down into the rock for some 70 or 80 cm. below the level of the Roman parodoi: by increasing the size of the arena a sufficiently high protecting wall could have been provided without digging down. We know, from the fact that in the east parodos the paving along the north side of the passage lies directly on rock, that the parodos floor in Roman times was never lower than at present. But if we assume a Hellenistic plan, greater than a semicircle, with a parodos further south, the rock level here is considerably lower, and the Greek orchestra could easily have been about the same level as the arena. This involves three more rows of seats at the foot of the slope of the koilon; nothing suggests a material change of pitch after the Hellenistic period. If we restore three rows of seats, and apply the Vitruvian square to the plan, it is interesting to see that it defines a line for the proskenion which is almost the same as that observed in the Roman period (fig. 5). On this basis the orientation of the restored, Hellenistic, parodos wall is such that, if prolonged, it would strike the intersection of the lowest row of seats and the diameter of the orchestra, a not unusual situation in Greek theater plans. The terrace wall, or outer wall of the parodos, fits in with the assumed proskenion, and the length of the skene is suggested by this relationship and by the assumed diameter of the orchestra. The depth of the proskenion must be assumed and may have been determined, theoretically at least, by the tangent to the orchestra circle.

One essential factor is lacking. There is no gutter and no cutting in the rock surface to suggest it, but the pitch given to the rock floor under the arena is sufficient to carry the water down toward the southeast; and probably it did so as well in earlier times.[41]

Where investigation was possible it seemed as though the foundations for the latest stone ring surrounding the post-arena orchestra rested on rock more carefully leveled than the general area. This would not be expected in the latest period, but in the preceding periods it would be normal. The trial trench cut diagonally across the orchestra in the first year of excavation was carefully cleaned in 1954 but no evidence of an orchestra ring was observed. Since only a relatively small area of the rock floor has been laid bare, such a ring to be shown by its bedding, cannot be entirely precluded.

As to the actual faint line of the skene, there is nothing conclusive. Mention has been made of

[40] J. F. Daniel, Notebook, 10-5-35, "0.65–0.80 below lowest block of diazoma foundation in packed fill under seats: 1. Lamp, type VII, 2. lamp, trefoil, 3. lamp, trefoil, (fragmentary). Stamped black-glazed ware, and 4th century B.C. tiles. Nothing later." The same pattern can be cited for other trials in the cavea fill.

[41] Segesta is another instance of a lack of gutter (Bulle, H., *op. cit.*, 114).

the fact that between the front of the pulpitum and the front of the Roman scaena, along the line B-B, a number of squared blocks and some smaller, irregular ones have been let in to the inequalities of the rock to provide a level footing. The general line that these occupy would be quite consistent for the footings of a hypothetical skene, and thus belong to the Hellenistic period.[42] Whether the rock level at the south side of the orchestra was always as low as at present is uncertain, but there is, on the other hand, nothing to show that it ever was higher. Hence, if the Hellenistic orchestra was originally some 0.70 m. above the arena floor, its southern part would have consisted of a fill of stone and earth. It seems altogether more probable that the first builders cut the rock down to the present level, and that after the orchestra had been raised by the Romans, it was once again lowered to form the arena.

The depth of the skene is uncertain, but its rear line was probably that of Wall C-C, for the entire structure of the present rear wall D-D is Roman.

As to the proskenion itself, the only recognizable remains are the six shafts of half columns (fig. 28) with a tongue extending back from them. The columns were polygonal, with twenty faces for a whole circle, but only thirteen faces were actually cut (No. 40, fig. 4). The diameters vary from 0.32 m. to 0.295 m., showing that they had diminution. The average length of each drum is 0.967 m., and if we assume two drums for each shaft and add a capital at one-half of the base diameter, the columns would have measured $2(0.967) + 0.16 = 2.094$ m. Adding an entablature one-fourth the height of the columns, or 0.52 m., we have a complete height for the order of a little over 2.60 m., or between 9 and 10 Roman feet, which is within the Vitruvian canon. The columns themselves would work out to a ratio of 1:6.6 for diameter and height. The sharp angles of the polygonal shafts, the lack of bases, and the diminution bespeak a Doric order. The projecting tongues, which are slightly wedge-shaped in plan, project back about 0.27 m. They have no exact parallel in Hellenistic proskenia, and the wedge shape suggests that they were intended to "key into" a wall. On the other hand, they may have been a means of anchoring wooden frames for pinakes. In later Hellenistic theaters a stone screen wall, with doors, may have been substituted for the earlier wooden pinakes. I can think of no other more probable use for such an order of half columns than for a proskenion recalling the high, Hellenistic type. The shafts were most carefully cut, with center pin-hole and scratch lines on the joint surfaces. On the other hand, the lateral faces of the tongues are rougher and suggest a later re-working. When we note that the columns were covered with a heavy, hard stucco in two coats and colored a deep Pompeiian red, we may suggest that the theater of the early Roman period retained the Greek proskenion and in doing so substituted walls with doors for the original wooden frames.[43]

With this rebuilding in the early Roman (Augustan) period we must associate the well-preserved angle (R) of a building on Wall C-C which occurs about 11.00 m. west of the central axis. Five courses of pseudo-isodomic masonry are preserved and, as noted, the direction of the west wall is not perpendicular to the line of the stage but opens out as it approaches the parodos. This "fanning out" or splay is reflected at the east in the remains of the foundations of the second Roman stage. The blocks of the wall face are smooth, just as in Wall Q (which could also be early Roman), and the length of this new scene building, carrying its ends well past the limits of the orchestra, suggests similar early Roman alterations elsewhere.[44]

There is, thus, at Kourion a further example to substantiate Dr. Bieber's statement regarding the retention of the Hellenistic high stage in the early Roman theater of the first century B.C. at Segesta.[45]

SCENE BUILDING, LATER ROMAN PERIODS

A definitive reconstruction of the Roman Scaena is rendered impracticable since so little remains.

[42] The quasi-rhythmic grouping of these "filling" blocks, while suggesting a scaenae frons of the Asia-Minor type, is somewhat asymmetrical, and hence may be quite fortuitous and not connected with the theater. They can also be explained by assuming openings behind the proskenion, and thyromata in the upper story of the skene (*cf.* Oiniadae, Bieber, M., *op. cit.*, fig. 330). If they are to be interpreted as interior supports for the skene, as at Eretria (*ibid.*, fig. 321) the front of the skene would lie so far north as to make serious difficulty in restoring the plan.

[43] Interesting parallels in Segesta (Bulle, H., *op. cit.*, pl. 23, Bieber, M., *op. cit.*, 335) and in Tyndaris (*ibid.*, pl. 37).

[44] As at Magnesia (Bulle, H., *op. cit.*, 262, fig. 6*b*, and Bieber, M., *op. cit.*, 230, note 36).

[45] *Ibid.*, 335.

In its latest period the scaena had an exterior length of 31.10 m., of which about four meters at either end were occupied by stair towers, as for instance at Aspendos.[46] The flanks of the scaena returned forward to meet the outer walls of the parodoi, and through these returns provision was made for the versurae.

Whether the entire depth of the foundation C-C was occupied by the architecture of the scaenæ frons and its backing wall is uncertain. If so, the stage proper was unusually narrow and would suggest that the high pulpitum as found in Asia Minor was used.[47] From the way in which the walls put in to "fair out" the arena terminate, it is certain that there was a wall or foundation built up to the northern edge of C-C, and in our hypothetical restoration we have filled this entire space forward from the south face of C-C. The floor of the long gallery behind the scaenæ frons would have been at a level over four meters above the present remains of the back wall. Probably there was a cryptoporticus or cellar below. The restoration shows a normal Vitruvian height for the pulpitum, but an alternate version is also outlined.

It is certain that there were two storeys of columns for the scaenæ frons in the marble period. More than this would be unlikely for a relatively small theater. The spacing of the columns is arbitrary, but conforms to the possibilities of the preserved cornice blocks. Unfortunately the only architrave block, save for a section which was actually a revetment, is a short one and projected at right angles to the scaena. It gives us, however, an indication that the line of the column centers was only about 0.65 m. from the face of the scaena wall, and this in turn makes the wall itself disproportionately thick, about 1.40 m., if we use the entire width of C-C. However, the rear (south) line of C-C seems to be associated with the back wall of the earlier Roman theater, of which an angle is still preserved, and in the rebuilding it is quite possible that the rear face of the scaena wall was set farther north. Or, alternately, the entire scaenæ frons, including architecture and backing wall, set further south, so as to provide a broader stage. In this case, the now vanished wall against which the arena "fairing" walls stopped should be assigned to the early Roman Period, and such part of it as was below the pulpitum level of the later theater remained undisturbed, until it was eventually swept away with everything else. Its total disappearance is an indication that it originally consisted of squared blocks which are dear to plunderer's hearts.

The scaenæ frons was provided, in the second period, with semicircular niches about 1.40 m. wide (some less) with half-dome tops. A number of the limestone blocks from these have been noted, and one shows the remains of a bronze pin indicating that they were revetted in marble,[48] probably in the late second century.

The seating capacity of the theater, after its enlargement, works out to about 3,300, based on an allowance of 40 centimeters (16 inches) per person.[49] In the Hellenistic period, it is curious to note that the capacity was about the same. But it must be remembered that there was probably no diazoma, and that the horns of the cavea extended around beyond the half circle. The theater of the early Roman period, when the horns were curtailed to make the analemmata parallel to the stage, would have contained fewer persons. It will be noted that at Corinth an allowance of only 36 cm. was allowed in the pre-Roman theater,[50] and if the same practice had prevailed at Kourion the theater would have contained about 4,300.

CONSTRUCTION

The best and most consistent construction is found in the great eastern buttresses, the outer wall of the east parodos, and to either side of the doorways through the ring wall, as well as the openings to the vomitoria. Massive, squared blocks are used set in a thin layer of white, or occasionally pinkish, gypsum mortar. The footing courses of the outer wall are of the same type, but in a number of places in the ring wall, and in the wall forming the inside of the corridor a type of vertical "chain" of blocks of different width is employed. The panels between are filled with carefully laid and mortared rubble. It is surprising to find that this occurs in the outer wall in the area of the great buttresses. The poor foundations of the outer wall at this point

[46] *Ibid.*, 376, fig. 494; for fuller reference, *ibid.*, 375, note 23.

[47] As at Sagalassos, *ibid.* 374, fig. 492.

[48] It is not surprising that more marble revetment was not found in the excavations. The lime-kilns built around in the ring corridor show clearly what became of it. Only a very few small fragments survived.

[49] Pickard-Cambridge, A. W., *The theater of Dionysus in Athens*, 140, 141, Oxford, 1946.

[50] Stillwell, R., *Corinth* **2**: 31.

have already been mentioned, as well as the more solid construction of the buttresses themselves. In the heavy wall forming the back of the stage building there is frequent use of large blocks set on edge, with backers, and held together in the next course above by blocks that extend for the entire thickness of the wall.

The pseudo-isodomic construction and finish of the analemma of the Hellenistic period has been discussed above, and also the very similar, but smooth faced, treatment of the Early Roman wall forming the north side of the east parodos, as well as the wall Q.

Masons' marks appear on various parts of the building. On a block of the south wall of the East parodos, the letters A Γ. The same mark appears on a fallen block of wall D-D, from the back of the stage. A seat block shows O A.

ARCHITECTURAL FRAGMENTS

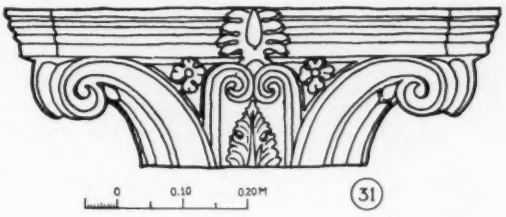
A number of architectural fragments as well as a great quantity of squared limestone blocks were found scattered in and about the building. The greatest number lay tumbled to the south of the stage where they had fallen (fig. 35). The narrow space left between the excavation and a high modern retaining wall built by the excavators resulted in the blocks being roughly piled one on another, and without a major expenditure of time and funds in moving and rearranging it was impossible to study many of them fully. As far as it appeared, in the summer of 1954, the most significant pieces had been placed in relatively accessible positions, but the following inventory is not a complete one. More extensive study might add some details to our knowledge of the stage building, but it is improbable that enough would be gained to be of great importance or to change the general conclusions.

In the following inventory the marble fragments are listed first, as being the most conspicuous, though they belong to the later phase of the building. The numbers in parentheses are those assigned by the excavators where they could be surely identified.

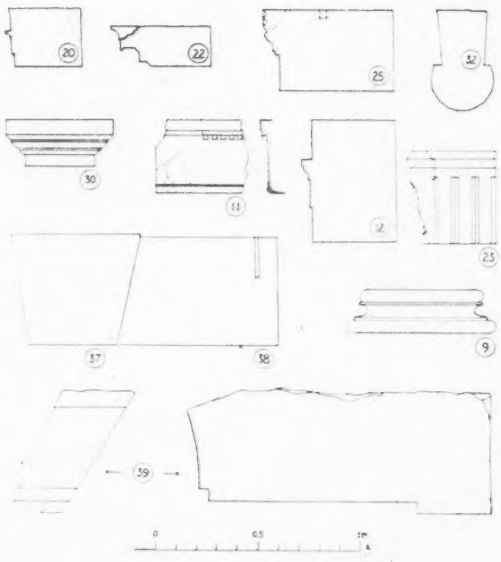
INVENTORY

Marble

1. Cornice, angle block (N.2014), figs. 36, 37, 38. Height, 0.305 m.; length of face on bed, 0.56 m.; depth on bed, 0.53 m. The back corner is mitered at 45 degrees showing that this was part



A.



B.

FIG. 34. Architectural details.

FIG. 35. Fallen blocks south of stage building.

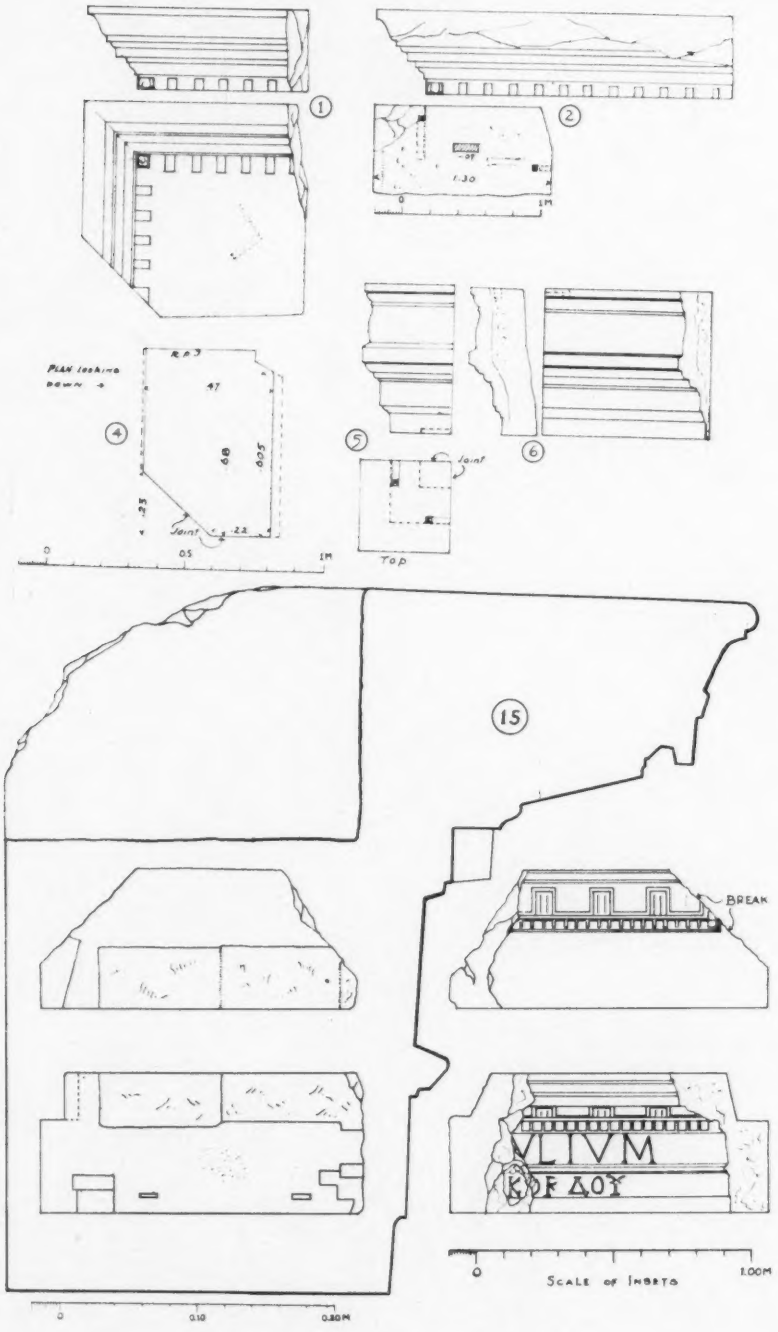


FIG. 36. Details of entablature blocks.

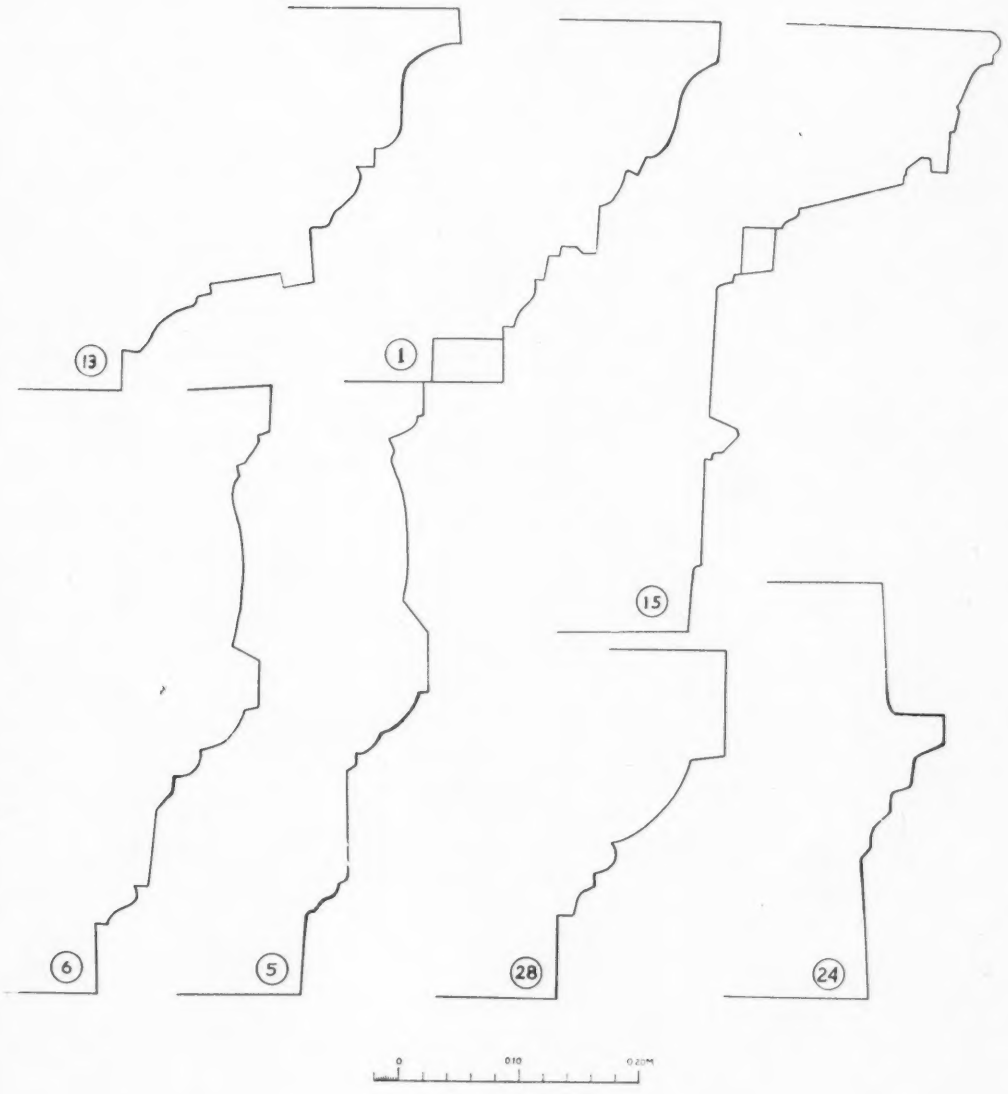


FIG. 37. Profiles.

of a cornice en ressaut with a projection of 0.050 m. Lewis hole in top.

2. Cornice, angle block (X2018), fig. 36. Height, 0.31 m.; length of face on bed, 1.05 m.; length of return, 0.46 m. Lewis hole in top;

3. Cornice, angle block (X2005). Height, 0.30 m.; length of face on bed, 1.93 m. Clamp cutting cuttings for hook clamps at end and back.

at right end; two clamp cuttings on return at left end. Same profile as No. 2.

4. Architrave-frieze (A4), fig. 36. Split horizontally in two pieces. Height, *ca.* 0.54 m.; length overall, 0.68 m.; length on face 0.605 m.; width on bed, 0.47 m. The right rear corner is mitered at 45 degrees. The right end and the mitered face are both joints showing anathyrosis. Left

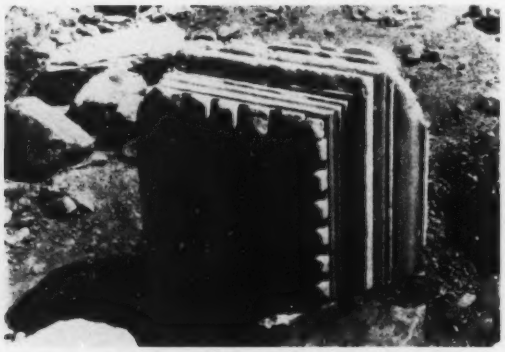


FIG. 38. Cornice, No. 1 (N2014).

end is rough-picked, and a miter for an interior angle appears on the forward part of the right end. The moldings are badly broken.

5. Architrave-frieze, angle block (N2027), figs. 36, 37. Height, 0.54 m.; bed, 0.22 m. by 0.225 m. Cuttings for hook clamps in top. The bed is recessed at the inner corner to a depth of 0.02 m., leaving a raised band 10 to 18 cm. wide on the outside.

6. Architrave-frieze (N2030), figs. 36, 37. Height, 0.53 m.; length on face of lower fascia, 0.59 m., length overall, *ca.* 0.61 m.; thickness on bed, 0.13 m. The left end is mitered, and anathyrosis shows the piece to be from an interior angle. Clamp cutting in top. The back is very rough and slopes forward. This piece evidently stood above a wall and is merely a revetment, carrying the entablature along the face of the scaena frons between the projecting elements.

Since only six blocks of the marble entablature remain, out of several times that many needed for the lower order of the decoration of the scaena frons, and since no two can surely be fitted to each other, we are left with some uncertainty as to their proper disposition.

Four (Nos. 1, 2, 3, 5) show exterior angles. One (No. 4) implies both an exterior and an interior angle, and one (No. 6) an interior angle. The obvious conclusion is that the entablature was broken out, en ressaut, over pairs or groups of columns, but we are ignorant of their spacing. No. 4 gives us the projection of the entablature from the wall behind: 0.605 m. plus 0.22 m., or 0.825 m. as measured on the lowest fascia of the architrave. The back lacks all but a shallow fascia; the face, from which most of the moldings have been broken, terminates at its inner end in a beveled cutting against which a piece of molded revetment could have fitted. No. 6, which is such a piece, has its bevel at the wrong end, but a similar piece, with bevel at its right end would fit perfectly. The inner end of No. 4, is rough-picked and would have extended, though not very far, into the wall. The width, 0.47 m., is the same as that deduced for the lower diameter of the spiral column drum, No. 8.

Thus the axis of the column below No. 4, and hence the axes of the entire series would have been about 0.60 m. from the face of the wall, or slightly less were there a pilaster behind the column. No. 5 with two contiguous molded faces and anathyrosis on the other two must have stood over an angle column and might even have been adjacent to No. 4. The sinkage on its bed, however, and the lack of any preserved clamp cuttings on No. 4 (though from the broken condition of the top this is not certain) make it doubtful that they ever fitted against each other.

The angle cornice, No. 1, can most easily be placed at the angle formed by the face of the scaenae frons and the return of the east versura. Its projection, only about 0.50 m., makes it impossible to use over any of the pairs of projecting columns, and hence above a piece similar to No. 4. If, however, we assume a column placed in the angle of the versura and the scaenae frons, and spaced nearer to the east than to the south wall, No. 1 may be satisfactorily located. There are no clamps in its top; the lewis hole is not located over the center of mass of the block, and it is possible to assume that it was originally somewhat longer in a north-south direction than it is now. This would have allowed it to project a suitable distance from the wall to accord with the projection of the pairs of columns.

No. 6, which finds a place between the sections of entablature en ressaut gives the impression of having been set into an already existing wall, in which a horizontal channel of the proper height and depth had been cut. The piece has no clamps for attaching it to the mass of the wall, nor would they have been needed since the bevel at one end, and the clamp provided to attach it to the next slab in the series would have made it secure enough, especially if its neighbor had been fastened to the wall behind. If this interpretation is correct the insertion of a marble architectural decoration points to a redecoration of the scaenae frons. It accords further with the fact that the only bases found that could go with the spiral fluted

marble column are of limestone, bases which may well have belonged to an earlier limestone decoration of the stage.

7. Capital, Corinthian, fig. 39. Height 0.48 m.; diameter at base, 0.41 m. Second-century type. The capital is cut from a coarse-grained marble and does not show especially fine technique, particularly in the case of the abacus where the upper ovolo is sometimes rounded, sometimes flat and more like a fillet. The leaves, however, are well designed, plastic, and vigorous in treatment. The loss of the overfall of their tips detracts from their present appearance. The spirals, inner and outer, spring from a calyx which is nearly hidden between the leaves of the middle zone. They are supported by leaves. There was once an ornament (a stem?) above the central, middle zone leaves on each face, but only stumps remain. The flowers of the abacus are more blocked out than carved.

At first glance it is hard to consider the capital as the work of any but a very late period, but the wide spacing of the leaves, their proportions and the generally plastic character suggest a date earlier than would at first appear. The rather compact proportions also suggest a comparison with the composite capitals from the Delphinion at Miletus,[51] dated early in the second century. A capital from the peristyle of Herodes the Great at Ascalon also has a strong, though crisper, resemblance to our example, but unfortunately it is not securely dated,[52] since it seems quite impossible that it can actually be associated with the time of Herodes. The tendency appears to be to draw the lower leaves closer together as time goes on, until their spikes touch, making lozenge patterns against the background of the capital.[53] Allowing for provincial work, which is only too evident in the construction of the remainder of the enlarged theater, we may suggest that our capital, and hence the remainder of the marble architecture should be dated late in the second century, or even in the early years of the third.[54]

8. Column, spiral fluting (N2002), fig. 19. Length preserved, 1.87 m.; Diameter at neck, 0.36 m.; at butt, 0.43 m. Square dowel hole with pour channel in top. Maximum diameter of astragal, 0.422 m. This would accommodate Capital No. 7.

Several fragments of spirally fluted columns, with an upper diameter of about 0.26 m. to 0.27 m. have been observed. These suggest a second storey of columns on the marble scaena frons, but no fragments of their capitals or other parts of the smaller order survive.[55]

Limestone

9. Base, Attic Ionic profile (N2099), fig. 34. Height 0.216 m.; diameter of upper torus, 0.61 m.; of lower torus, 0.74 m. Round dowel hole in top. A setting line, 0.045 m. back from the nose of the torus, gives a lower diameter for the fillet at the base of the shaft of 0.52 m. Deducting 5 centimeters for the flare of the apophyge, the actual lower diameter of the shaft would have been *ca.* 0.47 m. This would seem to fit reasonably with column No. 8. The combination of limestone bases with marble columns seems unusual. The fact is that not a single fragment of a marble base was found in the theater. It may be suggested that a limestone order for the scaenae frons that was built in the early years of the second century was replaced toward the end of that century, or

[51] Kawerau, G., and A. Rhem, *Milet* **1** (3): 143–146, figs. 22, 23, Berlin, 1914.

[52] *Palestine Exploration Fund Quarterly*, 114, pl. 22, London, 1922–1923. Also *ibid.*, 26, fig. 2, 1924–1925.

[53] Daniel Schlumberger (Les formes anciennes du chapiteau corinthien en Syrie, en Palestine et en Arabie, *Syria* **14**: pl. 32,1, Paris, 1933) shows a capital from the pronaos of the temple of Baalshamin at Palmyra which he dates about A.D. 130. But our example has no "lozenges" between the leaves as does the example just cited, though the capital as a whole has the same solid proportions. From the area of the South Gate at Gerasa (Kraeling, C. H., *Gerasa*, pl. 31,*b*, New Haven, 1938) comes a capital again rather similar, but again with lozenges. Henry Detweiler (*op. cit.*, 73) discusses the adjacent triumphal arch of Hadrian, dated A.D. 129–130, but leaves open the question as to whether it precedes or follows the South Gate.

[54] Rudolf Kautsch (*Kapitellstudien*, 5 f., pl. 1–1, Berlin, De Gruyter, 1936) discusses and illustrates capitals from Salone which, he says, are dated by Dyggve "um 300." While there are strong resemblances between the Kourion example and this series, especially in the schematic treatment of the space just above the tops of the lower range of leaves, I do not feel that our example can be so late. It would be necessary to assign the marble architecture to the last rebuilding of the theater, toward the end of the third century, and if one can judge by the very summary manner in which the building was reconverted from an amphitheatre an elaborate marble decoration of the scaena seems improbable.

[55] Gjerstad (*op. cit.*, 581, 582), in discussing the chronology of the theater at Soli where similar spirally fluted columns were found, dates it to the period of the Antonines, toward the end of the second century or in the early third. This agrees well with the suggested date for the Kourion capital. See also Benson, J. L., Spirally fluted columns in Cyprus, *Amer. Jour. Arch.* **60**: 385–387. 1956.

in the beginning of the following one by a marble order, for which the existing limestone bases were judged sufficient.

10. Base, similar to above (X2098).

11. Epistyle, Doric, fig. 34. Height, 0.36 m.; preserved length, *ca.* 0.41 m. Right end cut straight, but in a re-use. Length of regula, restored, 0.26 m. Back of block broken away. A bead is worked on the lower front edge of the epistyle.

12. Epistyle-frieze, fig. 34. Height, 0.60 m.; height of architrave, 0.41 m.; thickness at bed, 0.42 m.; preserved length, *ca.* 0.91 m. Both original ends appear to have been trimmed off.

13. Cornice, double-faced, fig. 37. Height, 0.324 m. The bed measures 0.85 m. from inside to outside; length, 0.77 m. This piece and the following one lay to the south of the east parodos some eight meters away among a litter of fallen wall blocks. It seems most probable that they formed part of a string course that marked, on the inside of the parodos, the spring of the vault.

14. Cornice. Same profile and dimensions as 13.

15. Entablature, including architrave, frieze and cornice, figs. 36, 37, 40. Height, 0.52 m.; length preserved, 1.18 m.; depth of bed, 0.28 m. from an interior angle. The soffit of the corona slants up and out. Shallow modillions 0.075 m. wide are spaced about 0.18 to 0.19 m. on centers. Each bears two shallow grooves. There are cuttings in the top and back for beams, and at the lower part of the back for wood, and also metal clamps to prevent the piece from rocking forward on its base. Also inventoried as inscription I 183 B, the piece bears on the frieze the letters IVLIVM, and on the face of the upper band of the architrave ΚΟΡΔΟΥ.

FIG. 39. Corinthian capital, No. 7.

FIG. 40. Inscribed entablature blocks, Nos. 15 and 16 (I-183 B, I-183 C).

16. Entablature, including architrave and frieze. Similar to above. On the frieze CI|VITATI, on the architrave ΤΩΡ (I. 183-C). Both pieces show from the breaks at their right ends (spectators' point of view) that they adjoined projecting elements of the frieze.

17. Entablature, exterior angle, from same series. The cornice is broken off. On the frieze, P; on the architrave, A. The return, which carried the same moldings, shows that the projection of the entablature was only about 0.22 m. since there is on that side the trace of an interior angle.

Professor T. B. Mitford, who is publishing these pieces along with the other inscriptions from Kourion, notes that they commemorate the construction of the Theater for the city of Kourion by the Emperor Nero through the proconsul Q. Julius Cordus, in A.D. 64/65.

18. Cornice, exterior angle (S 901). Joint in center of second modillion from angle. Modillions 0.078 wide, 0.19 m. on centers. The profile is similar to the pieces just listed above (15, 16) save that the molding above the corona is a cyma rather than a cavetto.

19. Cornice, fragment (S 940). Similar to 15, 16 and 18. Modillions 0.07 m. wide, 0.18 m. on centers.

A number of other small fragments of cornices from the same series exist but have not been inventoried.

20. Architrave-frieze, fragment, fig. 34. Preserved length, 0.29 m.; trimmed square at each end but the joints are not original. This would appear to belong to the above series and to have been squared off, and the cornice cut away before being re-used.

21. Architrave-frieze, fragment. Same profile as 20. Preserved length 0.27 m.; preserved depth, 0.34 m.; height to top of frieze, 0.30 m. Upper

surface fairly smooth toward front, but rough and backed toward center and rear. There was probably once an integral cornice element, later cut away.

22. Cornice, fragment, fig. 34. Height, 0.20 m.; preserved length, 1.01 m. Dentils 0.053 m. wide, 0.068 m. to 0.053 m. on centers. Right end has been trimmed off, and the piece is now incorporated in the foundations at the west of the stage building. A similar block, badly weathered lies just to the east.

23. Triglyph and metope block, fig. 34. Height 0.46 m.; width of triglyph, *ca.* 0.30 m. There is a cyma reversa molding at the top of the triglyph and above the metope. Left end of block preserved, but badly weathered.

24. Wall crown, fig. 37. Height, 0.35 m.; length 0.92 m.; thickness of bed, 0.77. The face is slightly curved in (0.005 m. in a chord of 0.88 m.). A similar block appears east of Vomitorium III.

25. Wall crown, fig. 34. Height, 0.35 m.; depth of bed, 0.57 m.; length, 1.60 m. Face slightly curved in. The lower part of the face rises vertically for 0.18 m. and then shows the start of a molding that projects, as now preserved, about 0.08 m. A tiehole once ran through the lip of the molding and on top of block is a weather line and a series of square holes, 0.38 m. apart as for a grille. The piece was found in the late Roman construction in front of the refuge and must be considered as part of the arena parapet.

26. Wall crown. Another piece of same series. Height 0.35 m.; depth of bed 0.18 m.; length 0.65 m.

27. Wall crown. Preserved length, 0.55 m. Same series as 26. Both found in ruins of east parodos.

28. Pedestal top, fig. 37. Circular. Height, 0.294 m.; diameter of top 0.88 m.; diameter of lower surface, 0.60 m. Empolion 0.09 m. square in bottom. A weather line setting back 0.03 m. from the edge of the top shows the size of a superimposed plinth. This piece lay almost exactly in the center line of the stage building and was at first supposed to have some connection with it. In raising the block in 1954, however, it was shown not to be *in situ*.

29. Base. Angle pilaster or anta. Height of base proper, 0.165 m.; total height including plinth 0.22 m. Regular Attic Ionic profile. The wall thickness was 0.45 m. at either end of the L. Built into the repair of the foundations at the west end of the stage.

30. Capital, Doric, fig. 34. Height, 0.23 m.; diameter at neck, 0.34 m.; abacus is 0.53 m. square. The echinus is divided horizontally into three bands by narrow fillets cut into the curve.

31. Capital, Corinthian type, upper half, fig. 34. Height, 0.24 m.; diameter at joint 0.35 m. Large volute scrolls rise to each corner. Two slender spirals curling against each other rise stiffly from behind the inner fillets of the volutes. A flower with elongated ovoid center and, to either side, four petals occupies the center of the abacus. Two stems curve inward to where they are linked by a rounded band just below the flower. In the triangular spaces between the inner and outer spirals are four-leaved flowers; the space between the inner spirals is scantily filled by a single acanthus leaf. The same pattern is repeated on the opposite side of the capital. The other two sides differ not only from the first, but from each other. On one, the inner spirals rise from behind the large outer ones, bend inward until they touch at the center line, and then swing outward, away from each other. The triangles above are filled each with a rosette, the space between the stems by an acanthus leaf. On the fourth side the inner spirals rise from a fluted stalk with small leaves at its top, and then curl outward after touching at the center.

The capital was found near the southeast angle of the theater, and there is no assurance that it belongs to the building, save for the matter of proximity. In dimensions it does not fit with the sections of inscribed entablature (Nos. 15, 16) especially since the latter shows a projection en ressaut of only about 0.30 m., sufficient to rest on a half or three-quarter capital, but surely not enough to allow for a four-sided capital with an overall dimension on the abacus of as much as 0.75 m. As to date, the piece bears a very close resemblance to the upper part of a capital from the gymnasium at Salamis tentatively dated in the Augustan period. If this dating is correct, and the inscribed entablature blocks from the theater are to be placed in the reign of Nero, we must suppose an Augustan reconstruction of the Kourion stage, for which there is some evidence. On the other hand, there is less than fifty years difference, and we do not have sufficient knowledge of the progress of architectural style in Cyprus during the first century of our era to be certain.

32. Half-column drum from Hellenistic proskenion, figs. 28, 34. Lower diameter, 0.32 m.; upper diameter, *ca.* 0.315 m.; length, 0.967 m. Worked for slightly over a half circle, with a wedge-shaped tongue extending back 0.27 m. Thirteen flat facets out of twenty for the full circle. Fine, smooth finish and traces of a pinhole in center with radial lines for laying out the sides of the polygon. The projecting tongue is roughly worked and seems to have been re-cut after its first use. The drum has been covered with a coat of hard stucco, colored a deep red, giving the half column a circular instead of a faceted form. The significance of the piece, together with that of five similar ones built into the same section of the back wall of the Roman stage building but not removed, has been discussed above.

33–36. Voussoirs. From a flat arch over the entrance to the Eastern Parodos. Because of the acute angle formed by the axis of the parodos and the exterior wall of the theater the doorway opening from the East into the parodos involved some interesting stereotomy. It was spanned by a flat arch of seven voussoirs that formed the lintel of the door. Their joints were parallel to the axis of the parodos, but their outer faces, and the rebate that repeated on their soffits the thickness of the door jambs, were parallel to the face of the outer wall. The soffit of the opening inside of the jambs was flat, and the flat-arch construction must have extended the entire thickness of the wall.

37, 38. Voussoirs, fig. 34. Two out of three which originally spanned a doorway leading from the southeast stair tower of the stage building to the central portion. The common use of flat arches for lintels, even over comparatively short spans is indicative of the friable nature of the local stone of which most of the theater was built.

39. Voussoir, fig. 34. On inner wall of corridor just east of Vomitorium 4. The stone, over 1.40 m. long on its lower side, formed part of a flat arch, from the extrados of which sprang the lower part of a curve forming a true vault. It would seem to be connected with the juncture between the entrance to a vomitorium and the ring corridor. The upper surface of the piece is badly weathered, and the back, or inner end apparently broken off.

Voussoirs, uncatalogued. A large number of voussoir blocks were found in and around the East Parodos and in various places in the ring corridor. The radii are hard to calculate with accuracy, since the soffits are often abraded, and the joints scarcely ever truly radial. The closest approximation gives a minimum of 1.29 m. and a maximum of 1.95 m. The average of eight blocks so measured works out to 1.68 m. for the radius, or a diameter of 3.36 m. At the base of the wall the parodos has a width of just under 3.00 m., so that either the vault was set back from the faces of the opposite walls, or the thickness of the walls themselves diminished as they rose. The discrepancy is perhaps not as great as would first appear since the voussoirs were set with mortar between the joints, and the surfaces that formed joints were cut with grooves forming N or X patterns as a means of providing a firmer, non-slipping bond between the stones. The thickness of the mortar cannot be determined, but with such a system, and a mean arc of 0.40 m. on the intrados for each voussoir there would have been eleven or twelve courses of voussoirs and twelve to thirteen joints. Only a very slight amount of wedge shape in each joint would bring the vault to the required span of 3.00 m. or a little over. The lengths of the blocks range from 0.50 m. to 0.85 m. In the circular passage were found some voussoirs of smaller radius, coming doubtless from the vault that covered it.

Column drums: Many limestone drums are scattered about the ruins. None are fluted. They appear to fall into two categories: (1) with diameters of 0.455 m. to 0.50 m. and (2) 0.39 m. to 0.42 m. In eastern sector of ring-corridor:

40. Diameter 0.455 m.

41. Diameter 0.46 m.

42. Diameter 0.50 m. to 0.48 m.; height 1.39 m.

opposite lower end of corridor:

43 and **44.** Diameter 0.50 m. In East Parodos:

45. Diameter 0.42 m. In orchestra:

46. Diameter 0.43 m. to 0.42 m.; height 1.31 m.

47. Diameter 0.39 m. to 0.385 m.; height 1.01 m.

48. Diameter 0.46 m. Square empolion.

Since the stage front in its final period was finished off in marble it is improbable that any of the drums listed above can be ascribed to it at that time. They may have come from the limestone period of the time of the Trajanic reconstruction, but in this case their survival, without any other architectural members to be associated with them is hard to explain. They may also, for the greater part, have come from the colonnade surrounding the cavea at its topmost level. No capitals remain to be associated with them.

CHRONOLOGY

1. *The Hellenistic Theater: second century B.C.*

The presence of a Greek theater with a high Hellenistic proskenion characteristic of the second century is adequately attested.[56] Its precise date is uncertain, but the majority of the Hellenistic coins found in the area being of the second century suggests that the construction should be placed in the latter part of the century, rather than earlier. In addition, the close similarity in masonry and stone-cutting technique observed in the early analemma wall to the monument above Tomb 8 at Ayios Ermoyennis leaves little doubt about the date of the former. The monument, according to McFadden, may be as early as the third century, but since the tomb was in use for some time there is nothing to prove that it may not belong to the second.[57]

2. *Augustan Period: after 15 B.C.?*

Cassius Dio (XXIII, 24, 7) speaks of a severe earthquake in 15 B.C. Earlier ones, 18 B.C. and 17 B.C., are recorded respectively by Eusebius and St. Jerome.[58] Augustus came to the rescue of Paphos and though there is no mention of Kourion it is possible that sufficient damage was done to the theater to require some restoration, and involve alterations as well. The parts most likely to have been affected would have been the high analemmata flanking the parodoi and the skene itself. We have noted that seat blocks, presumably from the "horns" of the koilon were built into the parados wall that replaced the one of Greek times, and that the half columns of the proskenion were refashioned and covered by a thick coat of hard red stucco. Wall Q in the southwest portion also suggests a modification of the regular plan.

3. *Neronian Period: A.D. 64–65*

This is represented only by the inscribed entablature blocks (I 183, A, B, C) evidently from a scaenae frons. They bear the name of Q. Iulius Cordus, proconsul under Nero, and are dated by Professor Mitford in his forthcoming publication of the inscriptions of Kourion in A.D. 64–65. The relatively modest scale of the fragments suggests a façade in keeping with the restricted size of the theater retained from its Hellenistic and early Roman phases. Save for minor matters, it would seem likely that all that Cordus did was to rebuild the stage. Inscription No. 82 from the Sanctuary of Apollo Hylates records, in connection with Cordus, the erection of a statue honoring Nero. Perhaps the rehabilitation of the stage front was a recognition of this gesture of the City of Kourion. Certainly, from that Emperor's well-known interest in the stage, the gesture would have been appropriate.

4. *Trajanic Period: A.D. 102–117*

To this period we must assign the enlargement of the Theater with the corridor and buttress walls, as well as the complete rebuilding of the parodoi, and the construction of the massive new stage building with its architecture still in limestone. Kourion saw much building activity at that time, especially in the great sanctuary of Apollo. Professor Mitford suggests a restoration of Inscription 111 as indicating the erection of a building from monies sanctioned by a proconsul in the early part of the second century. The fragment was found in the excavation of the theater, a little to the east of the east parodos. The coincidence may be worth something, since such an inscription would normally have been placed close to one of the principal entrances to the building. Further evidence is afforded by lamp fragments found in the footing trenches for the new corridor and its buttresses.[59]

5. *Late second century A.D.*

This period is marked by the replacement of the Trajanic limestone stage decoration by marble. The back wall was retained, but the parts visible from the cavea were revetted in marble. To this period may also belong the establishment of the stair tower between Buttress walls IV and V. A number of fragmentary inscriptions were found in and close to the theater belonging to the period

[56] I prefer to follow Dinsmoor (*The architecture of Ancient Greece*, 301, notes 1 to 4, 1950), in calling the high proskenion a second-century feature. While the building date of the theater may be earlier, and the proskenion changed later to accord with the new style, there is, so far as I have been able to observe, no indication to verify this hypothesis.

[57] See above, note 9.

[58] Hill, Sir George, *A history of Cyprus* 1: 244, 245, Cambridge, 1940.

[59] L.1187 = Broneer, Type XXV; L.1189 = Type XXV-XXVII; L.1155 = Type XXV (without handle). Cf. a lamp from Soli, *S.C.E.* 3: 354 "middle to end of first century." L.1181 = same. Broneer, Oscar T., *Corinth* 4, part 2, Terra Cotta Lamps, Harvard University Press, 1930.

of Septimius Severus. They indicate considerable activity. Inscription 95, for example, refers to an agonothete of the late second century who embellished or erected some structure, possibly the theater or some part of it.

6. *Early third century: Caracalla, about A.D. 214–217*

It is tempting to assign to this period the conversion of the theater into a hunting theater. Although Caracalla never came to Cyprus he was certainly not far away while he was in Syria, and it is quite plausible that Kourion prepared for his entertainment, should he arrive, by converting its theater. Dio[69] speaks at some length on the fact that hunting theaters were built wherever the Emperor spent the winter, or expected to do so.

7. *After A.D. 250: Re-establishment of the theater*

That this occurred no earlier than the second half of the third century is attested by coins of Philip the Arab, Elegabalus, and the Empress Otacilia, mother of Philip II, that were found in the fill of the refuge, and below the re-established seats.

8. *Destruction and abandonment: Fourth century A.D.*

Two violent earthquakes in the early thirties and forties of the fourth century were recorded for Salamis. These may well mark the end of the Curium theater. In any case, the latest coins found in the rooms behind the center of the stage building, underneath piles of fallen blocks, are of Valentinian and Valens, A.D. 364–375. The rooms further East, T.4 and T.5, were in use longer, and seem to have been given up toward the middle of the fifth century, but as noted above, they had nothing to do with the theater in their final use. The corridor around the back of the cavea when excavated was found to have been divided off by rubble cross walls, under one of which was found a coin of Theodosius I. By the last quarter of the century, then, the theater was only a great ruin, used both as a quarry and as a dumping ground.

[69] Dio, 78.9.7. For additional discussion see Stillwell, *Corinth* 2: 96.

ETHNOLOGICAL RESEARCH IN DARDISTAN 1958

Preliminary Report

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In the northwestern corner of the Indian subcontinent the three most eminent mountain chains of Asia meet—the Hindukush, Himalaya, and Karakoram. Most of this area is inhabited by Indo-Aryan or Iranian peoples. Two remote and almost inaccessible valleys, Yasin and Hunza-Nagir, are, however, the home of a population speaking Burushaski, a non-Indo-European language.[1]

In this paper we are concerned with the Indo-Aryans of these mountains. They must have separated from the main stock very early, in part perhaps even before the Aryan migration to the Indian plains took place.[2] Their languages form one marginal group which is called "Dardic." As they form a unity in many other respects too, ethnographers are justified in speaking of them as Dards or Dardic peoples.

The inhabitants of Kashmir originally belonged to the same subdivision of the Indo-Aryans, but they were linguistically and culturally assimilated to the peoples of the plains during a turbulent and rather cruel history.

The northwestern neighbors of the Dardic population, the Kafirs,[3] have attracted the attention of European scientists for more than 150 years. Surrounded by Mohammedan nations, they stubbornly preserved their pagan religion. Kafiristan thus became a real museum of archaic techniques, social institutions, rites, and ideas. It is perhaps one of the most regrettable losses to science that finally, a few years after the first European explorer, the famous Sir George Scott Robertson, had started his daring expedition, this anthropologists' paradise "was conquered by the Afghans who forcibly converted the people to Islam. Later expeditions of European scholars were unable to recover more than fragments of the ancient cultural traditions."[4]

The Dards[5] unfortunately did not succeed in arousing comparable interest.

Of course the first British officers and agents to enter the interior of Dardistan wrote lengthy reports,[6] but professional anthropologists never made much use of them.

Later on, service in the mountains became routine work, so only a few reports were written, mostly rather superficial ones.[7] There were, however, some exceptions. Among the native officials sent to Gilgit, Baltistan, and Ladakh there were two learned and interested men who wrote compilations which are lucid sources of information.[8] The linguist Lorimer devoted an invaluable but too brief paper[9] to "the supernatural in the popular belief of the Gilgit region."

From this general situation we can understand why even the pagan religion of the Dardic Kalash tribe was almost overlooked for a long time. The Kalash, also called Kalash-Kafirs, were not so fierce or so warlike by far as the true Kafirs beyond the Afghan border, but they had many traits in common with the latter and some peculiar to themselves which are even more interesting. Schomberg and Morgenstierne have given useful but incomplete information on this subject.[10]

[1] *Cf.* Lorimer, 1935-1938.

[2] Gujuri is only a dialect of Punjabi carried on by an intrusive group of shepherds and tenants. *Cf.* Morgenstierne, 1932: 43, 63.

[3] We are aware that they are now called *Nuristanis* by their Afghan overlords, but we will use the traditional term for practical reasons. Kafiri includes the dialects of Kati, Waigeli, Ashkun, and Prasun. According to Morgenstierne, 1926: 69, they do not form a separate branch of Indo-Iranian, but belong to the Dardic group as well, only they are especially archaic. The opposite opinion, later pleaded for by Morgenstierne himself, is presented by Buddrus 1960: 200.

[4] Heine-Geldern, 1957*b*: 282. A special bibliography exists, viz. Fazy, 1953.

[5] Peoples and tribes speaking Pashai, Tirahi, Shumashti, Gawar-Bati, Khowar, Kalasha, Dameli, Torwali, Gawri, Kohistani, and Shina.

[6] Leitner, 1876, 1889, 1894. Shaw, 1878; Biddulph, 1880; Cunningham, 1854. Durand, 1899; Ujfalvy, 1884, 1896.

[7] Schomberg, 1935, 1936, 1938. Stein (1903, 1907, 1921, 1928, 1942) was mainly interested in archaeology. Herrlich (1938) is more or less an outsider.

[8] Ghulam Muhammad, 1907. Hashmatullah Khan, 1939.

[9] Lorimer, 1927.

[10] Schomberg, 1938 (already mentioned). Morgenstierne, 1947. The article is based on observations made in 1929.

The same holds good for the easternmost Dardic strongholds. The villages of Da and Hanu belong to Ladakh and therefore never became Islamic. They only accepted a superficial veneer of lamaism. Here Francke noted ceremonial songs which could provide the key to the understanding of the basic religious ideas of the Dards.[11] But nobody saw the problems posed by even this wonderful material, and this explains why the members of the Filippi Expedition were more interested in the material culture of that area than in ancient beliefs.[12]

In the light of all this, it is no wonder that the Dards are not even mentioned in many works of general anthropology.

Only since World War II has there been a perceptible change in the situation. Then the Dards were finally discovered by professionals. For the first time the Dane, Halfdan Siiger, explored the Kalash systematically according to modern ethnographic methods.[13] The Norwegian, Fredrik Barth, following in the footsteps of Sir Aurel Stein,[14] penetrated Indus- and Swat-Kohistan and wrote an ethnographic survey which contains splendid sociologic observations.[15] Adolf Friedrich, the leader of the 1955–56 German Hindukush Expedition collected further singular material among the Kalash, assisted by Peter Snoy. Before this, he did field work with his whole team—Peter Snoy, Georg Buddruss and me—in the valleys of the Gilgit Agency.[16] One of the members—myself—paid a visit to the Brokpas of Baltistan.

Owing to Friedrich's untimely death at Rawalpindi in 1956, only a few preliminary reports have been printed as yet,[17] but one thing may already be regarded as sure: there are more pre-Islamic survivals in the Gilgit Agency than we ever dared to hope.[18]

By chance, an invitation from the Austrian Himalaya Society enabled me to return to the Gilgit Agency only two years later as a member of the 1958 Austrian Karakoram Expedition. The mountaineers of the expedition conquered Mount Haramosh (7,397 m.) under the leadership of Heinrich Roiss (who died during the next expedition to Mount Dhaulagiri in 1959). The scientific team was headed by the geographer Wiehe, the second member was the zoologist Pfiffl, I was the third. We all belonged to the University of Vienna.

Here only the main areas under investigation shall be mentioned. From April 27 to May 30, we did field work in the Haramosh valley, northeast of Gilgit. Between May 31 and June 24, we had our camp at Gilgit and visited a number of places, sometimes by jeep, in the main valley. From June 25 to July 2, we were guests of the governor of Gupis and thus got a useful introduction to the problems of this area. On July 3, we started in the direction of Tangir and Darel, already visited by me in 1955. There I collected supplementary data until July 23. During the following days I crossed nine passes, each more than 4,000 meters above sea level, to the valley of Gor, from where I arrived at Gilgit (August 7). During the next few weeks, we were busy at Peshawar and Rawalpindi inspecting the museum, or else packing up our collections. But between August 19 and August 28 we were again in Swat, and I visited the Torwali and Gawri-speaking population near Kalam. This route was considerably longer than that of my comrades[19] and my investigations more expensive. The difference was entirely covered by a grant of the American Philosophical Society to which I wish to express my gratitude.

Successful work in a difficult and rarely visited area was made possible by the permits given by the Government of Pakistan and the assistance of civil and military authorities, who afforded us every facility. My interpreter and guide during both expeditions was the headconstable of the Gilgit Police, Rahbar Hassan. I must extend special thanks to him.

All work between April 27 and August 7 was devoted to the Shina-speaking population of the Gilgit Agency. I think this research will provide new and essential information on their social and spiritual structure.

Only a short spell of reconnoitring activity was possible in Swat, among the Torwali and Gawri speakers.

The areas under investigation are at such a distance from one another and my intentions in each case so different that it seems best to give separate surveys of them.

[11] Francke, 1905.

[12] Dainelli, 1924, 1925: 104–127.

[13] Siiger, 1956: 12–35.

[14] Cf. Stein, 1942. This explorer, however, collected historical and geographical information only.

[15] Barth, 1956.

[16] This project was sponsored by the Deutsche Forschungsgemeinschaft.

[17] Jettmar, 1957*a*, 1957*b*, 1957*c*.

[18] Snoy came across most of them, I suppose, when he visited the Bagrot valley. His material will soon be issued.

[19] Cf. Wiehe, 1958.

ETHNOGRAPHY OF THE SHINA-SPEAKING DARDS OF THE GILGIT AGENCY

AREA AND POPULATION

Roughly speaking, the Shina language is the northern neighbor of Kashmiri.[20] Its basic area lies on both sides of the River Indus between the defile of Rondu and the wild gorge, where the river curving around the main range of the Himalaya turns to the south, to Indus-Kohistan.

The second center of the language is in the valley of Gilgit. However, some large tributaries (Yasin, Ishkoman, Hunza) are inhabited by different stocks.[21] Today this territory belongs to the Gilgit Agency and forms a part of "Azad Kashmir" which is administered by Pakistan.

Besides this, Shina is spoken in some valleys south of the Himalaya range. The western ones (Palas, Jalkot) are an inaccessible tribal area even today, loosely attached to the Hazara District (Pakistan); the eastern ones around Gurez, just on the doorstep of Kashmir, are on the Indian side of the cease-fire line of 1947.

Dialects of Shina, rather broken up by foreign elements, are still alive in some valleys of Baltistan among the "Brokpas,"[22] while the Baltis, the main stock, speak an archaic form of Tibetan. This territory, like all those mentioned before, is Islamic and under Pakistan rule.

The easternmost of these enclaves are around Dras and in Ladakh, that is, under Indian administration. As we have already mentioned, only the villages of Da and Hanu did not become Islamic.[23]

Before they were conquered by the English and their confederate, the Maharaja of Jammu and Kashmir, most of the valleys were under small local dynasties.[24]

Along the River Indus only, as in neighboring Indus-Kohistan, there existed independent communities eager to defend their liberty against foreign invaders but internally split by perpetual feuds. Their land was called *Yaghestan*, "Land of the Free," and it was famous for its anarchy.

Everywhere the Shina-speakers are divided into four basic nations or castes: Shins, Yeshkuns, Kamins, and Doms.[25] The Shins are often considered superior. Their proper home seems to be the northern part of Yaghestan, namely, the valleys on both sides of the River Indus below Chilas. This area also bears the name of *Shiwāki*, "Land of the Shins."

The very first explorers proposed to regard the Yeshkuns as descendants of the indigenous population originally speaking Burushaski. They supposed that the Yeshkuns took over the Shina language, when the area was conquered by the Shins, but remained a separate caste.[26] My observations confirm this theory. The toponymy also shows that Burushaski was spoken in the northern part of the Gilgit Agency.

Shins as well as Yeshkuns are Europoid, but there are some differences between these groups which indicate in most cases whether a visitor is a Shin or a Yeshkun.

Kamins and Doms are to be found even outside of Dardistan. "Kamin" is the term for a low caste of tenants and craftsmen in the Punjab and in the corner between the River Kabul and the River Swat. "Doms" is the general name of the gleemen, the musicians, in a still larger area.[27] There are definite indications that the stock of both groups came from the south, not only the social terms. Their racial type is darker and more slender than that of the original population.

Besides these four nations there are some outsiders: on the one hand, the descendants of the Islamic missionaries (Saiyids, Pathans) who enjoy a high social position, and on the other hand, some craftsmen, who are generally despised (akhcer = blacksmith, kulal = potter). Obviously both groups came too late to be included in the system described above.

Especially in the smaller valleys below Chilas (but not in the large ones like Gor or Darel), there is a numerous intrusive population, namely, of Kohistanis and Gujurs, still speaking their original languages. We shall discuss the reason for their immigration later.[28]

SUBSISTENCE AND ECONOMY

A large part of the material for this chapter was collected with Professor Wiche, whom I have

[20] As in so many primitive communities we have no real ethnic self-designation of the Shina-speakers.

[21] In Yasin and the Hunza valley (the States of Hunza and Nagir), Burushaski is the aboriginal language; the upper class of Yasin, however, speaks Khowar. Khowar is also used at the head of the Gilgit valley. Ishkoman is the home of Wakhi-speaking Iranians coming from the north.

[22] Brokpa means highlander.

[23] Exact boundaries are given by Bailey 1924: XIII., Francke, 1904. Shina is spoken by more than 100,000 persons.

[24] Biddulph, 1880: 41–45, 134–143.

[25] Biddulph, 1880: 34–40.

[26] This idea was opposed by Schomberg in 1935: 119.

[27] Reisner, 1954: 195, and Inayat Ullah, 1959: 37–39.

[28] Morgenstierne, 1932: 63, and Barth-Morgenstierne, 1957.

to thank for his suggestions. In his preliminary report the reader can find a lucid analysis of the geographical background.[29] The economy is based on agriculture with irrigated fields, mostly in artificial terraces, as well as on herding with intensive use of the high mountain pastures in summer and stall-feeding during wintertime. Maize, wheat, and barley are the main crops. At the bottom of some valleys even rice is cultivated. Millet, lentils, and some kinds of beans are sowed in the middle and higher, and buckwheat in the highest fields. Mulberries, apricots, grapes, and nuts, which can be dried, are the fruits preferred. Others, like peaches, cherries, apples or figs, are grown in regions which have foreign contacts. Only a few green vegetables were known originally.

In this pattern we observe three subtypes. Two of them may be explained by the different geographic and climatic conditions of the valleys.

1. Where there are several rather small patches of arable and irrigated land not too far away but at different levels, e.g. in a steep side-valley, they are used by a whole community in a system of transhumance. First, people seed the fields where two crops are possible, then the bulk of the population moves to the fields with only one crop and sows there. Afterwards some of them go with the cattle to the high meadows while the rest return to the bottom of the valley to start harvesting and sowing again. Finally they join the others in the pastures. In autumn, when the population goes down with the cattle, they harvest first in the upper and last in the lower fields.

Similar systems have already been described by Paffen[30] (Hunza) and Barth[31] (Indus-Kohistan).

2. In the broad valleys which have plenty of land at several levels, the soil can be divided among communities which have their fields round about them, so that there is no necessity for transhumance of the type just described. The fields bear two crops a year, only at the heads of some valleys are there settlements with one-crop land (Darel, Gor, Gilgit-valley). Even fallowing occurs.

In the southern part of the area, in Shinkari, there are sparse but widely extended forests of evergreen holm-oaks on the slopes of the valleys. Their leaves are used for feeding goats. The goatherd cuts the branches with an axe. It is not necessary to prepare any other fodder for them. Stall-feeding is restricted to a few weeks as much snow never lies there.

In such valleys the mountain pastures are mostly far off. Therefore, the bulk of the population normally remains at home in summer, and only the shepherds, generally unmarried youths, drive the cattle up.

There are valleys, too, in which entire families shift to the meadows, but then a special organization of the agricultural work becomes necessary. In some cases, two or three families, mostly headed by brothers, do the work in the fields together in turn. Or else a group of (foreign) tenants remains behind in the village for the same task.

3. Only in Tangir (south of the Gilgit Karakoram), where the climatic conditions of cultivation are excellent and two crops would be perfectly possible, do they have only one—maize. Almost all the agricultural work is done by tenants, while the original population are now small landlords who go on holiday, as it were, to the mountain pastures for the whole summer. The very best of these lie pretty far away, north of the Gilgit Karakoram, behind passes of 4,200 m. Here we may see an extreme evolution of the division of labor just mentioned.

Hunting (ibex, markhor, birds) is now more or less a sport and fishing of no importance.[32]

In some places the communities pay the craftsmen (blacksmith, potter, carpenter) by grants of land or an annual amount of foodstuff.[33] Today, however, their work is often done by tenants who need an additional source of income. All more complicated ware is imported from the bazaars of Gilgit, Chilas, or Mingora (in Swat). Home industry is not very efficient. Weaving is the task of the old (often blind) men. Tailoring is also sometimes done by men.

ERGOLOGY (MATERIAL CULTURE)

During my expeditions in 1955–1956 and 1958, I succeeded in collecting most of the things which form the technical equipment of the Dards.[34]

An exhaustive study will follow, but we can

[29] Wiche, 1958: 9–14.

[30] Paffen, Pillewitzer, Schneider, 1956: 30–82.

[31] Barth, 1956*b*: 18–23.

[32] The trout—which is found in some rivers—was introduced by the English. Trout fishing is the privilege of the military leaders and high officials.

[33] Barth, 1956*b*: 25–26.

[34] These collections were rendered possible by subventions of the Austrian Ministry of Education and are now in the Museum für Völkerkunde, Vienna.

already tell at first glance that in this respect the Dards of the Karakoram, the Kafirs and Dards of the Hindukush, the Iranians of the Hindukush and of the Pamir, as well as the Burushaski-speaking peoples, belong to an homogeneous cultural area.

There are only a few Dardic specialities, for example, the footgear made of leather or skin strips, the patterns of clothing and headdresses.

Not too much of the old inventory has been destroyed by acculturation in the last few years.

In the southern part of the Gilgit Agency, the mosques, wooden constructions on the graves, and sometimes also pillars and doors of houses are decorated by elaborate carvings. Samples were collected during the expeditions of 1955 and 1958. In a paper devoted to this subject, which was printed in the *Archiv für Völkerkunde* (1960), I discerned two stylistic trends. On the one hand there are rich carvings with scrolls, leaves, and flowers, especially clematis and lotus. These motives were already observed by Sir Aurel Stein. He explained them as a late offshoot of Gandhara art.[35] This idea can still be maintained, if in the modern way we understand by Gandhara an eclectic art containing Hellenistic, East Iranian, and Indian elements—and not a survival of Greek tradition since the days of Alexander.

But there is another style besides, which cannot be explained by this rich inheritance. It is prevalent in the embroideries, but also present in the carvings of Darel. The patterns of this style are mostly composed of simple straight lines, in a sort of chip-carving. The main pattern is formed by lozenges. Occasionally the spiral occurs. The instrument is a simple knife; no chisel is used. It seems to me that in some way this second style is related to the carvings of the Kafirs, and represents the actual local tradition.

SOCIOLOGY

In Dardistan each household is built around an elementary or polygynous family. Moreover the two smaller nations, Kamins and Doms, and the many newcomers from the south are organized in patrilineal lineages which have a tendency to endogamy. This is roughly the same pattern as that described by Barth for Indus-Kohistan.[36] The lineages are often called "khels," and this term has been taken over from the Pathans.[37] In many places the system has been adopted by the two leading castes, Shins and Yeshkuns.

The system of administrative bodies, the usual way to solve conflicts, and common law are quite similar to the forms Barth recognized in Indus-Kohistan.

Every community is headed by a council called "jirga"[38] which has to settle minor quarrels. In some places I was able to find out that the members of the jirga were chosen by a kind of "senior line autocracy" as in the Duber-Kandia area, in others they were the representatives of settlement units. But even there, strong antagonism among the castes is evident. Where the village is divided into quarters,[39] the jirga is built accordingly. Even at the meeting place each faction sits separately, sometimes on a special wooden platform. Important decisions are made by a big jirga in which the headmen of several villages or even valleys meet.

The influence of the religious leaders is rather restricted.

The whole system is highly inefficient and opens the door to all sorts of feuds between factions, so Barth calls it "acephalous." In Yaghestan, the "Land of the Free," the system has held undivided sway in some valleys even up to the present day. We have already heard that from time immemorial in the north of Dardistan it was combined with the cruel rule of small princes of pretended foreign origin whose mode of life was probably influenced by East Iranian ideals. It has been adequately described by Biddulph.[40]

When the Dogra-Rajas of Jammu and Kashmir conquered the country they became heirs to this tradition. Afterwards the English took over the initiative. They left the princes of Hunza and Nagir as feudatories, and for the area south and west of Gilgit they introduced a system developed in the tribal areas of the Afghan frontier and Swat.

According to the "Frontier Crime Regulations," the husband has still the right to kill the guilty couple in cases of adultery. Simple murder is punished by a fixed penalty—fourteen years in chains—which has never yet deterred any brave and honorable Dard. So in many cases the relatives of the deceased prefer to settle the case themselves—and to pay the inevitable penalty of

[35] Stein, 1928: **1**: 10–12.

[36] Barth, 1956*b*: 28.

[37] "Khel" is a common term among Pathans.

[38] "Jirga" was originally a Mongol term meaning "circle" which without doubt reached them by the Pathans.

[39] *Cf.* p. 85.

[40] Biddulph, 1880: 34–45.

fourteen years' imprisonment. The right of the husband is also theoretically accepted in the unadministrated area. When "put into practice" a blood feud results between the lineages involved. It may even be followed by a small scale war which spares only the women. The case will finally be settled by paying blood money on both sides.

The system of adoption is highly interesting.[41] Only one method is possible: the foster-son must have the mother of the new family as a wet-nurse. Even a full grown man must undergo this symbolic action. After that he will never dream of approaching his new milk-mother sexually. Therefore, if any suspicion of adultery arises, such a ceremony will be forced by the husband on the suspected partners.

It seems that even the milk of animals once had a similar connecting power. Apparently in the mind of the Dards husbandry is based on the adoption of man by the animal.[42]

Without the permission of the lineage, no land can be sold to an outsider. Contrary to the Islamic law of inheritance, no land is given to a daughter. If there are no boys in a family, the son-in-law may get the property. He is looked on as adopted.

In all the valleys of Dardistan, tenants ("dehqáns" or "dagáns") are employed, but on quite different terms and to a widely varying extent.

The basic pattern of economic and social relations between farmer and tenant is the same as described by Barth in Indus-Kohistan.[43]

> The tenant . . . performs all the manual labor connected with raising a crop (apart from assistance given by the master at the time of harvesting and threshing) but has no capital invested in it—seed, tools, and animals are supplied by the master. In return for his services the tenant receives ⅓ of the crop.

This pattern is to be found especially in valleys using dehqáns of foreign (Kohistani, Gujur) origin, e.g. in Tangir. In places where dehqáns have their own houses and tools and even their own animals, a better share may be fixed (one third to one half). This may happen if the dehqán is a resident of the area, perhaps a Kamin, who has some land of his own but not enough. In all such cases the dehqáns are "not tied to particular fields, persons or localities." They are free to seek a new and better master.[44]

Often the position is different—and much crueler: If the immigrants do not get a "dehqánship" big enough to feed themselves and their families, they have to borrow grain from their masters. The terms are absolutely usurious. If the tenant cannot return grain with interest after the harvest, he is bound to pay in money instead—at the price usual at the bazaar of Gilgit! So after a while the Kohistani has a debt of 5–600 Rupees. At this moment the case is settled in a different way. The tenant has to work in the fields of his master all day without getting a fixed share. Instead he gets foodstuff for himself and his family, at times clothing too, and a salary of 12–20 Rupees for the whole year. Half of the money is kept back by the master as interest on the debt. The other half must cover the most urgent needs. The man is practically a slave, for he may be sold to a new "owner" for the amount of his debts. His sons are heirs to his liability, because the debt, never diminished but rather enlarged, is passed down to them.

Yet people come streaming in from the south and accept the terms. Indus-Kohistan is overpopulated and this chance of having fixed employment means that the basic foodstuffs are guaranteed.

Most of these facts would perhaps have emerged from an exhaustive study of the older sources. But I think we have found some additional material (which may open a new chapter on the social history of Dardistan). There are two social patterns preserved by the two leading castes in remote places. Clear evidence of one of them was detected first in the northern part of the Gilgit Agency, in the Haramosh valley, so we may call it the Haramosh pattern.

According to my informants there the people are divided into tribes called "roms." A rom is the military unit in case of any attack. A middle-sized valley of about 500 houses forms one rom, larger valleys are subdivided. In some cases, however, several roms, each in its own valley, are united to a higher unit (whose local name I do not know).

A rom may consist of several nations. Each nation is again subdivided into "dabbars," i.e. patrilineal groups who once were exogamous and may be classed as clans. Sometimes the dabbar is also called "tukur,"[45] an expression which was

[41] Biddulph, 1880: 77, 82–83. Schomberg, 1935: 190.
[42] Leitner, 1876: part III: 34; 1894: 41.
[43] Barth, 1956*b*: 24.
[44] Barth, 1956*b*: 25.
[45] E.g. Gor, Chilas.

translated to me as "house" or "building." Each dabbar bears the name of an ancestor who lived seven to nine generations ago. A song, normally composed by his sister, glorifying this man was used as their symbol, a sort of shibboleth, especially during the marriage ceremony.

Several dabbars of one rom, sometimes even those who belong to different "nations," may be connected by a genealogic charter. In this case the informants explain that their forefather had several wives from the "nations" in question. The expression "tukur" is occasionally used for such a higher unit. (The community of a village has no real place in this order.)

When Biddulph gives notice of "subcastes" in the social order of the Dards in Baltistan, which is the same in all respects, it is clear that such dabbars are meant. "Rom" is mentioned by him as a self-denomination of the Brokpas.

According to discussions after the expedition, I think that in 1955 P. Snoy already observed the same system in the really archaic Bagrot valley culture. His material will be published in the near future.

A quite different structure was found in some conservative villages of Shinaki. As it was best preserved at Phuguch (Darel) I will call it the Phuguch pattern.

There are patrilineal groups called dabbars as well, but they are by no means exogamous. Some dabbars, normally either Shins or Yeshkuns, seldom mixed, together with some loose families of newcomers or lower castes, form a higher unit, and again some of these (four to six) form the village. The chief point is that the "quarters"[46] must be of absolutely equal size, e.g. sixty families. Obviously the dabbars of the smaller and politically less important nations have been broken up and their families divided to comply with the fixed rate.

At present the role of this rigid system is not too important. The soil is private property, but fields and houses of one quarter lie together. One meadow is sometimes considered as the common property of a quarter. Even tenants on common land may pay their dues for it. The quarter forms a unit in the distribution of water from the canals to the fields.

But twenty years ago there was a system of periodic re-allotment of fields and pastures in some places. The whole area belonging to a village was classed as fertile land, poor land, and meadows, and divided into subterritories which rotated among the quarters. The quarter dealt out the shares to each family. As for the size of a share, in some cases it depended upon the number of all the members, in others upon the number of the males only. After five to thirty years the distribution was renewed.

In this system the jirgadars are primarily considered as trustees of the quarter.

As for the origin of the system, Barth thinks that "the principle on which this system is based is quite simple, and occurs also among other Indo-European speaking peoples (Pathans, Baluchis, ancient Celtic and German tribes)."[47] But that is only half the truth. I myself was several times told by my informants that the rotating of land started when their forefathers became Muslims. This is correct, because in Yaghestan, Islam was introduced by the Pathans and brought a big wave of Pathan patterns with it.

If we consult historic sources,[48] not the shadow of a doubt remains but that the whole system was simply taken over from the Pathans. When the Jussufzai conquered Swat in the sixteenth century, they divided their tribe and the valley into equal parts. Finally there resulted 30,000 shares for male and female, old and young.[49] In some districts the system of re-allotment was abandoned by order of the Wali, the mighty and efficient ruler of Swat, only twenty years ago.

It was from Swat that the first Islamic (Sunnite) missionaries arrived in Darel.

North of Shinkari the Pathan influence is insignificant. There, Islam came from Kashmir (Shia) or from Badakshan (Ismaelia) and no customs of that kind are to be found.

SETTLEMENT PATTERN

In a few remote and very conservative valleys only, there are village-fortresses which are so narrowly built that the roofs practically form one single platform with several huge, crude towers. A strong place is always chosen. The walls of the houses form a continuous line of defense. Inside of this ant-hill there are corridors and stairs be-

[46] They are called so even when they form the fifth or sixth part of a village.

[47] Barth, 1956*b*: 3–32.

[48] Thorburn, Tupper, Raverty, Ridgway. *Cf.* the excellent resumé given by Reisner, 1954: 104–183.

[49] Reisner, 1954: 114. In the meantime Barth has written an excellent survey about Swat, so I think he himself would easily admit the connections. *Cf.* Barth, 1959.

tween the houses.[50] Once at some little distance there lay one other house, reserved for parturient and menstruant women and forbidden to men.

The stables lie still farther off, and together with the threshing grounds they represent a separate unit which looks like another village. A considerable part of the males—the unmarried youths—live here permanently.

There are indications that in the old days the inhabitants of such a "pueblo" removed for agricultural work in summer to additional non-permanent hamlets, some on the sites of the summer villages of today but others in the two-crop area at the bottom of the valley. The "village-fortress" lay in an area splendidly prepared for defense and with healthy climatic conditions, but well away from the fertile land.

Originally all the inhabitants of such a village-fortress belonged to one "nation," to a patrilineal descent group, moreover (a dabbar or a group of dabbars). I think "tukur" originally designated such a pueblo and therefore became a synonym not of the "family" but of the "clan." This observation is an argument that the ancient settlement pattern of the Dards corresponds to the Haramosh pattern.

There is a second type of village likewise narrowly built with small paths between the houses. The stables often lie apart. The village is called a "kot." The population may include all nations, and wards exist reminding one of a former partition into quarters. Its position is at the bottom of the valley in the center of the arable land. Often there is a tradition that the first Islamic apostle founded it—and this seems to be correct.

It is highly probable that these villages in the south, in Shinkari, were systematically built when the Pathan-inspired reform of land and the social order took place and the Phuguch pattern came into existence.

Today in the whole area the bulk of the population lives in hamlets. In the north this form has resulted from a disintegration of the old clan-dwellings of the Haramosh type, a process which was greatly welcomed and favored by the administration of the princes. The new permanent settlements carry on the tradition of the former additional footholds at the bottom of the valley.

In the south, most of the hamlets[51] are of a relatively recent date. They sprang up when the Pax Britannica spread in the Karakoram and the fortresses which belonged to the Phuguch pattern became superfluous. At some places villages have already become a mere administrative and social term. Only the mosque and the smithy show the site of the one-time center. There is a tendency, however, for kinship-groups to concentrate in detached places. This is easy to understand because, even when re-allotment was abolished, the land still formed a unit. The steady conflicts between the kinship-groups helped on this evolution.

The last stage of the process can be observed in Tangir. Not only the villages but in many cases even the hamlets have been dissolved. Like medieval knights, the landed proprietors settled with their dehqáns in the center of their fields and built formidable towers for defense during many bloody feuds.

All the places where the dehqáns—Kohistanis, Gujurs—have separate houses, form only loosely knit hamlets, which shows the late influx of the owners. Especially in the smaller valleys of Shinkari, e.g. between Darel and Gor, Gor and Chilas, is the main stock of the population made up of such dehqáns, copyholders of the proprietors in the large valleys. Strangely enough the ruins of older compact villages are to be found in the same small valleys.

This can be explained by a glance back at the martial history of the area: In the constant wars between the valleys which, according to many tales, prevailed in Shinkari for centuries, the population of the small and not too fertile valleys was ground between the mighty centers—Darel, Gor, Chilas. The princes were killed or driven away, fields and villages destroyed. The large valleys, the "republics" in Biddulph's sense were interested in getting a glacis, an empty zone, around their borders for the sake of defense. Therefore, they did not allow any re-settlement of the "valleys between." They only used them for temporary meadows.

The situation changed completely when Gilgit and Chitral came under British rule. In spite of Yaghestan's remaining an unadministered tribal area, warfare between whole valleys became impossible. There was still plenty of killing then, even more than before I think, but all inside each valley. The rajahs of the north who so often had tried without success to conquer the republics were removed. The boundary zone lost its former meaning. Therefore, a new wave of colonization followed. The owners gave their

[50] I found the best examples at Gor and in Baltistan among Brokpas who came from Chilas and Astor 300 years ago.

[51] "Het" is the local name.

pastures to tenants, dehqáns arriving from overpopulated areas in the south, and enjoyed an easy income. They became landlords. Whole quarters as well as individuals acted like this, as the system of re-allotment was quickly decaying in the meantime.

This explains the peculiar distribution of languages in the Shinaki country. Shina is spoken only in the main valleys, in the smaller ones it is replaced by Kohistani and Gujuri, the original idioms of the dehqáns.

Tangir possessed plenty of buffer meadows as well, but they lay too high and too much exposed to be colonized in the same way. On the other hand, this valley was more progressive for other reasons. So the tenants settled in the main valley. At that crucial moment agricultural work was simplified by the growing of maize. The latter had been displacing ancient crops, especially millet, for a century. The contemporary economy of Tangir results from this peculiar situation.

RELIGION

The whole of the Gilgit Agency is Islamic, but the apostles came from different directions at different times. In the northwest (including Hunza) as in Badakhshan the people are Ismaelis almost without exception. Their missionaries may have been the very first to arrive. They were, however, not very efficient. In Nagir and in the eastern part of the Gilgit Agency, Shia predominates. Conversion was due to the influence of Kashmir or the dominating role of the Baltistan princes during the sixteenth and seventeenth centuries. Shinkari in the south was conquered late but radically by Sunnite mullahs starting from Swat. They were Pathans or at least completely "Pathanized." Their offspring can still be identified in each valley.

Below the official confession there exist some forms of superstition which are shared by many Moslem nations,[52] especially by Pathans and Tadjiks.[53] Most of them were evidently spread by the mullahs themselves.

Other non-Islamic ideas and customs are typical of Dardistan. Many of them, already noted by attentive observers like Leitner, Biddulph, Ghulam Muhammad, Lorimer, and Schomberg,[54] we could still recognize, but under the patient zeal of Ismaelite, Shiite, and Sunnite mullahs, saiyids or achuns supported by the local authorities,[55] they have lost much of their former virulence.

The local festivals, the "Great Days of the Shins" so wonderfully described by the old authors, are still known in remote places, yet they are stripped of most of their impressive ceremonies. Today they merely offer opportunities for considerable feasting.[56] The shamans of the Dards, the daiyals, have also lost much of their former importance. They are restricted now to a few villages. Female daiyals, who were especially shocking to the Islamic mind, have practically vanished. The taboo of the Shin caste not to touch any part of a cow, not to drink its milk, and not to eat its meat, is at present observed by a few individuals only (shamans, hunters), for a short time, when ritual purity is required.

The great cosmogony, quoted only once by Ghulam Muhammad, in which the land is brought from the bottom of the sea by a diving animal, could nowhere be confirmed.

A great part of the population is actually afraid of witches. They were described to us in the same way as to Lorimer and Schomberg.

But in 1955 the members of the German Hindukush Expedition noticed important ideas either not at all or else inadequately mentioned in previous works. Thus, it transpired that the taboo in connection with the cow was only the counterpart of goat-worship. As this is not shared by Iranians and Burushaski-speakers, it must be considered as specifically Dardic. In regard to wild goats, which are believed to be even purer than their domesticated descendants, there exist specific beliefs and rituals. Each hunter needs a "protecting fairy." The night before the hunt he is not allowed to spend with his wife. The fairy will then appear to him in a dream and announce on which mountain top he will meet an ibex or markhor; otherwise he will not get any. Therefore, when the hunter eviscerates the prey immediately after killing it, he throws away a few pieces of the liver in the name of his fairy. She

[52] They believe in "peris" = fairies who as a rule are benevolent. Other female demons threaten mother and child. Jinn are known as well. "Tawiz" are amulets with verses of the Koran worn by man and animal.

[53] Andreev, 1927: 56–95 *passim*.

[54] *Cf.* Leitner, 1876, 1889, 1894; Biddulph, 1880; Ghulam Muhammad, 1907; Lorimer, 1927; Schomberg, 1935, 1936.

[55] After some bad experiences Mohammedan officials only were appointed to the leading positions of Gilgit by the Kashmir government, among them excellent men like Ghulam Muhammad and Hashmatullah Khan.

[56] Biddulph, 1880: 100–106.

is also said to be extremely fond of the fresh, steaming blood.

Ibex and markhor, collectively called "mayaro," pass for the domestic animals of the fairies, their sheep and goats. Therefore, no animal of this kind can be killed by man which has not been slaughtered before by those ladies. After the meal they reanimate it by putting the bones together and covering the skeleton with the skin. Then they leave the resurrected animal to one of their chosen men who is just performing the dreami ceremony. Still more data will be available when Peter Snoy, who alone visited the extremely promising Bagrot valley in 1955, publishes his material.

During my expedition of 1958, I came across a lot of new and astonishing religious complexes too which would never have been reconstructed on the basis of older descriptions. Only here and there did Ghulam Muhammad get some scraps of them, but not enough to understand them. Some traits more were observed by Peter Snoy. Most of them were found in the northern part of the Gilgit Agency, at several places in the Gilgit valley, and in the Haramosh valley near the border of Baltistan.

In Haramosh the dabbars still preserve the tradition of how they were "founded" by their ancestor in "Kafir" times, long ago. When a man was wealthy and strong and already had his own large family, he chose a big slab on the mountain slope. Then he gave a great feast at the "biyak," the dancing and assembling place of the area. The whole community came together, men and women. They drank wine and danced in complete sexual abandon. So many goats had to be slaughtered that the biyak was all covered with wine and blood. When this condition was fulfilled and no impure (menstruating) woman was among them, at the climax of the feast the big slab mentioned above came staggering down into the valley and stopped finally on the rim of the biyak. From this moment on the stone was the symbol of the future dabbar who carried on the name of the feast-giver. Moreover, it was considered as the home and seat of the protecting spirit. By succeeding generations this "protecting spirit" was identified with the host, the ancestor of the clan himself. He would take care of the fields and demand regular offerings, mostly of goats.

The stones of the ancestors called "botebát" stand upright like menhirs. I was able to take some photographs near the ruins of a former kot. Most of them had been turned over by Islamic fanatics. Before the standing stone there was often a smaller one lying on its side. It was used as a chopping-block for dividing the meat of the slaughtered animals. At some places it seems to have been connected with the female principle. Once I was told that such a stone had been brought by the grandmother in a similar rite. During the marriage ceremony the bridegroom had to sit down on the "male" and the bride on the "female" stone. At other places there were separate stones for this ceremony, "hilal-e-bat" and "hilalebat."

But not only ancestors were celebrated by a monument. In honor of a woman who lived a pure life without fault (adultery), observing certain taboos (such as not to step over crossroads directly) a platform was erected by her paternal family. The walls were built of big stones, the center filled with gravel. A chair was put on this "táli," and she had to sit down on it, richly ornamented. A goat, also decorated, was led towards her and was exhorted by the elders to pay honor to this "sili" (= holy) woman. When the animal bent its neck, this sign was accepted as a proof of her dignity, and a big feast would start. The monument of that ordeal was called "sili-táli."

There are hints too, that a man of the senior line in the tukur had priestly functions. Even under Islam he had the right to begin seeding and harvesting. In pagan times perhaps the sili-woman had corresponding rights and duties.

Other cults are connected with larger territorial units. All the women of a valley [57] worshipped a female deity, the Murkum. She helped in delivery and protected mother and child; yet she was also the chief owner of all ibexes and wild goats denoted by the collective term of "mayaro." [58] Therefore, she was venerated by hunters, too, who brought her horns.

The great thrill of the investigations I made in the Haramosh valley was finding a sanctuary of the Murkum in good order and even in use, in spite of two hundred years of Islamic past. It lies almost 3,000 m. above sea level near the summer village of Guré, just in front of the tremendous flank of the Haramosh, and this is no accident, as the mountain was considered the proper home of the Murkum. On the steep slope

[57] Perhaps large valleys were divided into sections.

[58] At some places also the urial, the wild sheep, is included.

there is an altar built of boulders dominated by a cliff as big as a house with a juniper tree growing beside it. Next to it is a spring. Below the altar, crude benches of stones were erected for the annual meeting of the women. Nut trees grow between them. Even they are considered holy and no branches were ever broken off.

I was told that, when the village was founded, the goddess appeared in the shape of a she-ibex on that cliff promising happiness and fertility. Every year the women were to gather here. Then she herself would send the sacrifice—a she-ibex.

One man only was allowed to join in the ceremony, the priest of the Murkum, the "zhabán." It was his duty to kill the ibex and to divide up the meat on the altar. This was eaten by the women sitting on the benches below. Then the priest danced before the goddess (without clothes, as some audacious people maintained) taking liberties with the surrounding women. The women, however, would beat him and torment him to their hearts' content. No man was allowed to oppose the behavior of the zhabán. It seems that he even had full sexual rights on all women of the valley. He was called "buck of the womenflock." Lorimer has given most valuable information about a similar officiant—but one officiating for a more restricted circle, a "private party" of ladies of the village, the "rū.i" or witches. The "mitu" is their "aider and abettor." When the rui assemble on their secret biyal, taking a human "soul" with them (in the shape of a goat, as Buddruss found out), the mitu is "used as a sort of human anvil on which the victim is dismembered, or else he himself chops him up."[59] I think it is evident that here we are concerned with a "black mass." The meeting of the witches and their ceremonies faithfully reflect the normal assembly of the womenfolk. The mitu is the infernal colleague of the zhabán.

It must be emphasized that all the statements of Lorimer, modestly called in question by himself, were fully supported by our own findings. Even the rather strange function of the mitu as a chopping-block is confirmed. Normal instruments of this type have a similar name. The same term is also used for the ("female") stone lying before the botebat.

The ministry of the zhabán is now abolished, but women anxious about the welfare of their families still come to the altar table and put leaves of juniper between the boulders. When I visited the place, I found fresh, green branches there. In Haramosh I also saw another sanctuary of the Murkum, stone benches on both sides of the path between the winter and the summer villages. When people shift over in springtime, no woman who has borne a child since the previous autumn will pass here without distributing bread in honor of the Murkum and putting some juniper branches between the rough stones of the benches.

Today in this northern area they do not remember a male god of any importance comparable to that of the Murkum. They showed me a sanctuary of the men below that of the Murkum in Haramosh, but it was supposed to have been destroyed by a stone avalanche long ago, when a man had come to the sacrifice without having purified himself in the smoke of juniper leaves after intercourse.

We have heard that tales of fairies exist almost everywhere, but in some remote valleys the fairies are considered as smaller images of the Murkum, perhaps as her younger relatives. They have preserved their aboriginal name of "darnìji" instead of the Persian "peri."

In a village on the borders of Punyal I was told of a sanctuary of Murkum and her suite. It was described as a big menhir surrounded by many similar but smaller stones. The locals explained that Murkum and her maidens could rest only on hilltops. The highest mountain is the residence of the great goddess herself, on the others there sit the darnijis. If you want to receive them you must build hilltops in miniature, models.

One group of the darnijis wear the white caps of the unmarried girls. It is their duty to help the hunters and the shamans. As everywhere in the Gilgit Agency they are called "racchi," i.e. "helpers," "guards." When they appear to the hunter in a dream in order to grant him an ibex they do not bring him flowers or fruit as is otherwise related, nor do they simply betray the whereabouts of the deer, but they present him with a human head. Apparently that means the "soul" of the mayaro which is to be the victim.

If there is a war on between the valleys or only great hatred between two tukurs and a man is ready to kill an enemy, he waits for the racchi to offer him the head of an ibex in a dream.[60] The next morning he will start on the man hunt sure that he will succeed.

[59] Lorimer, 1929: 531.

[60] This happened in a feud between two tukurs of Haramosh, only twenty years ago.

The fact that just a head is surrendered by the racchi may be explained by the custom, abandoned only a few generations ago, of taking the head of the slain man home.[61] Then the village would celebrate the killer by a great feast. The women danced around the head; afterwards it was used as a poloball and finally fixed over the gate of the village fortress. The tukur of the hero had the right to erect a stone bench in his honor.

In the Gilgit Agency it is a common belief that among the fairies there are men and women. The darnijis proper, however, are regarded as female, their male partners are demons likewise residing on the highest mountains. These "yamālos" are feared as ferocious hunters. Their prey are human souls in the shape of mayaros. They shoot them with bows and arrows and eat their flesh. Afterwards they put the bones of the soul-mayaro together, and the victim comes to life again and runs away. The human "double," however, must die shortly afterwards.

Much more affable are demons called yachōlos. They protect the houses and their owners, but have the bad habit of stealing grain from the threshing place. Therefore it is necessary to lure them away with a good meal when the corn is shot into leather bags.

In Kaltaro, a side valley of Haramosh, I traced a special custom to protect the crop against noxious animals and vegetable diseases. In springtime a couple of young goats are chosen. When the herds go up to the high meadows, they alone will remain in the agricultural area. There they may feed anywhere and even eat the crop. No one is allowed to disturb them, they are sacrosanct. If they enter a field, it means good luck and blessing to the owner. When the people come back in autumn, the buck is killed and eaten by the men at a ritual meal.

It was possible to collect some information about the cosmological ideas of the Dards. They told me the following story, widespread in Iran:

Below is the sea. In the sea there swims a fish. On the fish there stands a bull, on one horn he carries the earth. On the earth there lives a man, and over the man there flies a bird. When the bull shifts over the disk of the earth from one horn to the other, there will be an earthquake.

If you go on asking who the first inhabitants of these valleys were, they tell you of superhuman beings, "devākos," who built channels and sowed corn, but after a year had to shift to a new place, because otherwise their crop became poisonous. The devakos were related to the fairies; therefore they had mayaros as domestic animals. Owing to their industry you will still find traces of channels and fields everywhere even in steep and difficult places.

In the south, in Shinkari, the religious pattern is different in many respects. There are traditions of stone worshiping in pre-Islamic times, but in fact no dabbar could show me the "stone" of his ancestor. No traditions of "feasts of merit" as described above could be traced, the erection of sili-talis is not common.[62] There exist, however, traditions which may be interpreted as "megalithic": In Darel a story is told of a giant, who was a man-eater, living in the valley. For each victim he used to erect a stone. They are still in their places.

In a valley north of the River Indus belonging to the republic of Gor, there is a big stone with a smaller one beside it surrounded by many other boulders. The explanation is given by a tale: The devakos, Muner and Sher, were brother and sister. When they were with their herds on the way to the meadows the brother wanted intercourse. The frightened sister then asked him first to bring her water in a sieve. But the devil told him to smear the sieve with clay, so he succeeded in fulfilling her condition. In her despair the sister prayed to God, and He turned all—man, woman, and animals—into stones.

Yet the arrangement of the stones is reminiscent of the type of sanctuary which the locals described to me in the upper part of the Gilgit valley, with a central stone for the visiting main deity and smaller ones round it for the fairies of the suite.

Human heads were used as trophies here as well, but no tales about stone monuments for the hero existed.

Shinkari is rich in tales of fairies, especially in connection with the chase. In the free area hunting was never restricted as in the principalities of the north. But there are no shamans, and the names of Murkum or the darnijis are unknown.

On the other hand, the idea of a central male god has been preserved with surprising clarity. In fact there seem to be protective gods in each valley with different names, e.g. Taiban in Gor, Naron in Chilas,[63] but all belong to approximately

[61] Human hands also served as trophies.

[62] Only once noted in Gor.

[63] Already mentioned by Biddulph in 1880: 15 and 17.

the same type and have the same characteristic features. Their sanctuary is a crude stone altar (or a menhir?) in the center of the valley. The place is surrounded by a forest of holm-oaks. This grove is regarded as holy. Impure things have to be kept away. No twig is allowed to be broken. Even a belt of fields encircling this area is regarded as pure. Only the manure of goats is to be brought here, never that of cows.

Here, most of the festivals common in the Gilgit Agency are connected with the male deity. The most important of the whole year is called Boinion.

With regard to the ceremonies we see that not only the juniper tree is holy here but also the holm oak. If the "chili," (= juniper) in the north is the counterpart of the mayaro, a similar correspondence may be observed here between holm oak and domestic goat. They depend on each other. Therefore, you are permitted to cut such a tree only if you kill a goat and smear its blood on the trunk.

In closing this brief survey I should like to draw attention to the fact that the information given on economic, social, and religious institutions of the past fits together perfectly. The religious affinity between holm oak and goat reflects the economic stage when the branches of this tree alone were used for winter feeding. This is only possible for goats, never for cows.

The pueblo-like structures were inhabited by a dabbar or a group of them. The religious institutions presuppose the existence of dabbars.

REFLECTIONS ON FOREIGN CONTACTS

The belief in the great owner-goddess of the animals exists in Caucasia in many variants.[64] The idea is quite common there that the hunter can capture his prey only by her consent. Sometimes her favor even goes as far as to accept him as her lover.[65] But the lucky hunter has to observe certain taboos; otherwise he must die. Sometimes the goddess appears in the shape of a "pure" animal. The precise idea that a slaughtered animal may be revived from its bones occurs in both areas. Even the detail that a missing bone can be replaced by a rod is identical.[66] Here as there, the belief is connected with wild goats, and this must be a very old affinity, because Thor, the Germanic god, plays the same trick on his bucks.[67]

Today there is a vast empty distance between the two centers, the Caucasus and the Hindukush Karakoram, but once perhaps similar beliefs existed on the Iranian plateau and were destroyed in the course of the violent history of this area. The Iranian Fravashi-conception may have evolved from such a basis.[68]

That goat-worship existed among the mountain tribes of Iran can hardly be doubted in view of the Luristan bronzes. Many seals of Western Asia depict goats beside a tree. Maybe this connection had the same economic background in the Karakoram, i.e., intense goat-breeding and the use of evergreen trees for winter feeding.

It is quite evident that there are similarities with the institutions of the Kafirs. Through Robertson's excellent work we know that they had "feasts of merit" and went head-hunting.[69] They were acquainted with altars in the shape of mountains and fumigated with burning juniper.

Moreover, the Kafirs of the Hindukush venerated a goddess who appeared as a wild goat[70] and her residence on the highest summit—the Tirikh Mir. I am no linguist, but I think that even her name, Krumai, indicates a connection with the Murkum of the Gilgit Agency. But Krumai is an outsider in the rich Kafir Pantheon; perhaps she was taken over from a Dardic tribe.

In fact, the religion of the Dardic Kalash in Chitral, who are neighbors of the Kafirs, is still more closely related. Perhaps the jestakhouse,[71] the socio-religious center of a lineage group, was not too far from the tukur of the Shina-speakers.

Like the true Kafirs the Kalash had shamanistic rites (but neither of them have the specific "Siberian" traits which I noted among the Shina-speaking Brokpas).

The Kalash have plenty of the peculiar rites and beliefs connected with the wild and domestic goat. This constitutes a very important link with

[64] Vinsaladze, 1958: 72–75.

[65] Dirr, 1925: 140, 143. If a man has killed more than a hundred ibexes, the marriage with his fairy is celebrated in some places in the Gilgit Agency.

[66] Dirr, 1925: 139–140.

[67] L. Schmidt, 1952: 520–524.

[68] On the basis of his Iranistic studies, Friedrich recognized this interesting relation first. In his last letter to Professor Baumann he wrote (Nov. 28th, 1955): "Neue Anregungen gehen von diesen Feststellungen aus für das Problem eines Zusammenhanges zwischen dem altjägerischen Spiritualismus in diesen Gegenden und der iranischen Fravashi-Lehre."

[69] Robertson, 1896: 449–477, 561–577.

[70] Robertson, 1896: 384.

[71] Siiger, 1956: 16.

the Eastern Dards[72] and reveals a significant difference from the Kafirs.

Looking towards the east, we find customs and beliefs very near to the complex described in Da and Hanu. This is not surprising, because those villages, even in Ladakh, speak Shina. Francke collected the songs of the Bono-na festival there.[73] No doubt Bono-na, the "Day of National Pride," is identical with the Boinion festival which is well remembered if not actually held at Gor. The ceremonial chase described by one of the songs seems to be the central act of many other Dardic religious rites. It is based on the conception that it is the hunter who brings the supernatural down to the land of men. The partition of the prey means a sort of partaking of the holy body. The animal can be replaced by a branch of the holy tree, because animal and plant are only two different aspects of the divine.

What Shaw[74] said about the use of juniper by these easternmost Dards and their prejudice against the cow fits perfectly into the Shina pattern.[75] The institution of a priestly caste and the existence of a village-fortress where each family had rooms in case of war also run perfectly parallel to what we are able to reconstruct in the Gilgit Agency.

In the Gilgit Agency we have observed monuments of a definitely megalithic type and customs which are characteristic of societies erecting such structures. In this connection I wish to mention that Prehistoric megaliths have been described by de Terra in Kashmir.[76] Similar stone-circles exist near Peshawar, but have never been thoroughly studied.[77]

That megaliths occur in great number among the Tibetan speaking peoples of the Eastern Himalaya is a well-known fact. Only one example may be quoted here. In the Lepcha territory there still exists an open-air shrine devoted to the god of Mount Kanchenjunga. It consists of one central stone representing the main peak, i.e. the god himself. He is surrounded by smaller stones representing minor hills, i.e. his soldiers or followers. Next to this there is a similar group, the central stone of which stands for the wife of the god, the smaller ones for her suite.[77] This is a striking parallel to structures I noted in the Gilgit Agency.[78]

A plate in the work of Tucci shows that wooden images astonishingly similar to those of the Kafirs and Kalash were made in Western Nepal.[79] Perhaps the same idea lay behind them.

Moreover, megalithic monuments have been observed in Tibet proper, especially in the north-eastern part.[80]

In the Tarim Basin, Sir Aurel Stein and Folke Bergman found some graves which apparently belonged to the autochthonous population of the area. Their racial type is different from the ruling Iranian or "Tokharic" nations, but resembles the mountain tribes in the Pamir and Hindukush. These very graves have traits related to our Dardic complex.[81] Images apparently erected for the dead[82] are the most surprising example. But there are also bare animal bones sewn in neat order to a piece of felt, and this presupposes the belief in a resurrection of the body from the bones.[83]

Megalithic structures, "feasts of merit" and head-hunting are widespread among the tribes of Southeast Asia. It is the same complex which seems to be characteristic of the whole Dardic area.[84]

On reviewing these similarities we cannot help coming to the rather annoying conclusion that, in spite of their linguistic position, the Dards have not very much in common with the culture of the "Vedic" Aryans. For the Kafirs proper one might find some links (e.g. the Kafir god *Imra* may have evolved from *Indra*), but the eastern Dardic peoples with their goat-worship and their prejudice against the cow, the holy animal of the Indians and Iranians, are quite separate. They are much nearer to the mythological concept of Caucasian peoples. There are several possible explanations.

1. The first is to assume that Caucasian mountain tribes migrated with the Aryans (or independently of them) to the marches of Hindustan.

[72] Not only the Shins reveal this trait, but also other peoples, e.g., the Torwalis of Swat-Kohistan.

[73] Francke, 1905.

[74] Already observed by Biddulph, 1880: 53.

[75] De Terra, 1942.

[76] For this information I am indebted to M. Curiel and Dr. F. A. Khan.

[77] Siiger, 1956: 42-44.

[78] Near Shukiot, near the border of Punyal.

[79] Tucci, 1956: fig. 33, p. 38.

[80] Maringer, 1949/55: 317-320. Hummel, 1959: 176-177.

[81] This correct observation was made by Herrmann in 1931 (p. 33).

[82] Bergman, 1939: V.

[83] Bergman, 1939: VI/2.

[84] Heine-Geldern, 1927, 1957, 1958.

This possibility was already envisaged many years ago by Heine-Geldern [85] when he wrote that the Indo-Aryans perhaps took "some of the tribes they met in the course of their migration" to India. Strangely enough, bronze axes with a certain resemblance to Caucasian types have been found in the Karakoram.[86]

2. A second possibility is to assume that such "customs spread from the East along the Himalayas." [87] But what else would suggest that such a cultural diffusion started in Southeast Asia and reached as far as Caucasia?

3. A third proposal seems to be more convincing, namely, that these elements were taken over by the Dards from mountain tribes who had formed a real koiné, a continuous chain north of the argicultural (and later urban) centers in the lowlands between Asia Minor and India, before the great migrations of the second millennium B.C. These tribes had taken over the agriculture of the peoples in the plains as well as their husbandry. In the west they concentrated their interest on goat-breeding. The goat was perfectly adapted to the mountains and crossed with the holy animal of the past, the markhor, which had played a dominating role in the economy of the hunters. In all other respects, too, they had preserved the old traditions. They must have enjoyed considerable independence and even wealth. Maybe under the stimulus of the graded societies and the buildings of their "civilized" neighbors they had created "feasts of merit" and "megalithic customs." Even head-hunting can be explained by such an impact.

In an excellent article, Baumann has shown [88] that all these complexes have strange affinities with the "high cultures." I think we may add that they were developed in the marginal zone of the city-states.

This hypothesis alone can explain the existence of an eastern wing of relations along the Himalayans to Assam and to Southeast Asia (with megaliths, head-hunting etc.) because no Indo-European people could have been the bearer of the diffusion. We would then suggest that similar tribes also lived further east and were absorbed by Tibetans in the Nepal Himalaya and by Nagas in Assam.

Comparable features among the "Iranians" offer no difficulty. They may have been adopted anywhere in Iran proper.

We have to remember that the "mountain peoples" played an extremely important part in the history of the Ancient East. Several times they ruled Mesopotamia. The Luristan bronzes have grown up from them. They were still a considerable force in the time of Alexander the Great.[89]

An extensive part of the Dardic vocabulary is non-Indo-European. We may assume that it corresponds to the foreign element in the social and religious structure and was adopted from the mountain tribes in the same way.

With this last hypothesis the question immediately arises, whether or not the Burushaski-speaking Yasinis, Hunzas, and Nagiris are the direct descendants of this hypothetical mountain population. In fact, they share a good deal of the special institutions discussed above, megalithic customs, "feasts of merit," shamanistic rites.[90] They also have the idea of an owner of all animals [91] and had a priest similar to Murkum's zhaban.[92]

But there are arguments against such an identification as well. They never had the aversion against the cow so typical of the eastern Dards. Moreover, Buddruss and I noted the characteristic myth of agriculturists that the corn was in the hands of the fairies once, and came to men by theft. This means perhaps that the Burushaski-speaking tribes were at first farmers and mixed with the hill tribes. Perhaps they lived, as recently suggested by Heine-Geldern in the Indian plains and were driven into the mountains by the invading Aryans. There is another, quite different possibility, namely, that they belonged to the

[85] *Cf.* Heine-Geldern, 1936: 24/1.

[86] They are the remains of a big hoard. I was able to buy them and hand them over to the Archaeological Service of Pakistan. A preliminary report is printed in this book.

[87] Heine-Geldern, 1957: 282.

[88] Baumann, 1958: 227.

[89] Only after heavy fighting could he cross the land of the Uxians (near Susa) who were shepherds and herdsmen (Arrian, Anabasis III/17). Moreover, it is by no means clear that all the tribes whom he had to defeat in Swat were really Indo-European.

[90] I think there are arguments to include technics of ecstasy into the spiritual heritage of the mountain peoples. The northern shamanism has got many impulses from there.

[91] But in a story recorded at Gilgit, he is considered as male.

[92] Lorimer, 1935, 2: 263. The tale of Daltas Manuko can only be understood on the basis of similar institutions.

pre-Indo-European population of Eastern Turkestan and came from the north.

We are now in the wide and dangerous field of speculation, but one thing is clear: If we have any hope that the roots of the Dardic social and religious systems go back to the time of such a pre-Indo-European koiné of mountain tribes, then it is urgently necessary to start intense field work immediately, in order to save as many traces of the past as possible.

RECONNAISSANCE IN UPPER SWAT

The narrow uppermost part of the Swat valley is the homeland of Gujurs who arrived relatively late, and of "Kohistanis,"[93] i.e. Dards, speaking Gawri and Torwali.

There are traditions that the main body of the Torwal tribe came from Patan in Indus-Kohistan and that one section of the Gawri tribe inhabited the Punjkorah valley before, but besides this, both tribes surely contain the remains of the aboriginal population of the Swat valley who were driven on to the hilltracts by the Pathan invaders.[94] If there were hope anywhere of restoring traditions that go back to the great days of Buddhist civilization, it would be here.

Already Biddulph, however, declined such a possibility. He wrote that "the Torwalik have been too long converted to Islam and exposed to the preaching of Swat mullahs to have retained any customs connected with other religions." The Gawri-speakers, who had then been Moslems for nine generations only, did not have "the peculiar customs still common among the Shins"[95] any longer either, according to Biddulph.

Barth, who recently gave a careful and reliable survey of both tribes, records so few pre-Islamic traits in his material that he more or less confirms the statement of Biddulph.[96]

We must, however, ask whether the old traditions have really been completely destroyed or whether it is only so difficult to get any information because people do not dare to speak being intimidated by their religious leaders. In the latter case, a careful investigation would still have a chance in future.

My research, assisted by an intelligent Pathan interpreter, Irfan ud-Din Ishrat,[97] only aimed at shedding light on this question. I noted the following complexes:

A. Each hunter needs a protecting fairy (peri). She appears in his dream to indicate the whereabouts of the wild goats; she helps in aiming and finally drinks the blood of the dying animal. A certain tree is consecrated to her. She hates cows as being impure and likes goats. Her residence is on the highest mountain.

B. Stories about witches are widespread. A considerable part of the male population is actually afraid of them. They are called rī or rāvi. Sometimes they are said to live on hilltops (a confusion with a bad, dangerous kind of fairy?), but generally they are ordinary women of the village during the day, only to be recognized by a sort of bloodfilled bump on the top of their skulls. If this bump is opened, a witch loses her evil power and becomes normal again. When she leaves her house at night her feet are turned backwards. When she can get hold of a man she eats his heart, and the unlucky fellow must die in a short time.

But it must be emphasized that similar ideas also occur among the Pathans of Swat. There a woman becomes a "shisha," a witch, when she neglects the ritual ablution (after intercourse) seven times. During the night such shishas secretely leave their homes and climb on trees. Riding the trees they fly to foreign countries and have meetings there. Other witches of Swat prefer to ride on hyenas. The rough hair over the spine of this animal is said to give them extreme sexual pleasure.

Among the Pathans, even ordinary women (not witches) are sometimes said to practice a sort of black magic. If a woman wants to attract the love of a man she will go to the graveyard and dig out the body of a man just buried. She will hang the corpse on a tree and pour water on its head. Then she collects the water dripping from its feet in a vessel and finally takes a bath in it. Then she becomes extremely beautiful, so that no man can resist her, not even her own husband.

C. There are many stories about holy places, e.g. a pool where a golden cup appears at regular times. But I found no system and no connection with other Dardic beliefs in them.

I think some conclusions may be drawn even from this scanty material.

[93] "Kohistani" is the general name for hill tribes speaking a language different from Pashtu but bordering the area of Pathan conquest. *Cf.* Biddulph, 1880: 69.

[94] Barth-Morgenstierne, 1957.

[95] Biddulph, 1880: 70–71.

[96] Barth, 1956*b*: 67–68 and 75–76.

[97] I have to thank him for his honest and unassuming helpfulness.

1. The rich spiritual world of the late first millennium A.D., when in Swat Buddhism and Sivaism converged into a symbiosis and gave birth to so many Tantric systems, is not yet entirely dead among the hill tribes and has even affected the Pathan invaders. To this day the women, who once had "chiefly the monopoly of the Tantric relevations and of Tantric percepts in Swat,"[98] are said to be versed and dangerous witches. They still perform black magic in graveyards, using dead bodies as in the time of Padmasambhava.[99] They are still able to fly in the air. Perhaps this special power has given its name to the whole valley, for the old name of Swat, "Uḍḍiyana," may be traced back to the root "ḍī" = "to float in the air."[100]

And when the peris stimulate the hunters and lead them to the spot, are they not following in the footsteps of their "grandmothers," the dakinis,[101] who did the same in the field of spiritual experience? Even the peculiar riding on a wild animal (hyena?) was customary among them.[102]

2. It is evident that the survivals noted in Swat fit into the common Dardic pattern. The peris of the mountain tribes have the same characteristics as the darnijis of the north. The witches of Swat, the ri or rāvi, are connected with the rūi of the Shina-speakers, even by their name.

This means that we can also use the much better preserved traditions of the northern Dardic tribes to reconstruct the popular beliefs from which spiritual leaders like Padmasambhava drew inspiration when they enlarged the spiritual world of lamaism.

The popular beliefs of Gilgit actually had a direct influence on Tibet. The teachers who gave a literary form to the primitive Tibetan Bon religion, came partly from this area and used current shamanistic rites and ideas.[103]

Whereas in the first part of this study we have seen that the economic, social, and religious structure of the Gilgit Agency can help us to lift the veil from the distant past, near the roots of agriculture and husbandry, in the second part we find that this very material may be used to explain some specific western traits in the lamaism of Tibet.

[98] Tucci, 1958: 283–284.

[99] Hoffmann, 1956: 43.

[100] Tucci, 1958: 283.

[101] For this comparison I have to thank Dr. Buddruss, Frankfurt/Main, and Professor Hoffmann, Munich.

[102] Hoffmann, 1956: p. 43.

[103] Tucci, 1958: 282.

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BRONZE AXES FROM THE KARAKORAM

Results of the 1958 Expedition in Azad Kashmir

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I

BEFORE 1947 most of the Karakoram belonged to the State of Jammu and Kashmir. A part of this area, including the famous principalities of Hunza and Nagir, was leased to the British and administered by a Political Agent residing at Gilgit. After partition and a period of cruel fighting the territory was divided into two parts by a cease-fire line.

The East—Ladakh and the valleys immediately surrounding the basin of Kashmir—belongs to India. The West, with Gilgit as a center, forms a part of Azad Kashmir, i.e. Free Kashmir, and is administered by Pakistan. It is still called Gilgit Agency as in British times. On the southern border of the Gilgit Agency on both sides of the River Indus there was a large tribal area barring the direct way into Swat and into the Punjab.

The tribal area was called Shinkari,[1] because the inhabitants were mostly Shina-speaking Dards. They were famous for their bravery and their spirit of independence, but also for lawlessness and robbery. Murder and blood-feuds went on almost constantly. They had no higher political organization so that Barth[2] speaks of them as "acephalous" communities.

The area was in general completely closed to foreigners. Sir Aurel Stein was able to enter the two large valleys of Tangir and Darel only because a conqueror, Pakhtun Wali Khan, had temporarily imposed his rule on their inhabitants.[3] Soon after Stein's visit Pakhtun Wali Khan was murdered and the old disorder prevailed for another thirty-five years. A few years ago, however, the elders of the two valleys decided spontaneously in the spirit of Islamic unity to introduce law and order by bowing their necks under Pakistan. The valleys became part of the Gilgit Agency and are now administered by an Assistant Political Officer (A.P.O.). His residence is Shumari in Tangir. This enabled the members of the German Hindukush Expedition of 1955, Professor Adolf Friedrich, Dr. Georg Buddruss, Peter Snoy, and myself, to enter this formerly forbidden country for linguistic and anthropological research. Owing to Professor Friedrich's untimely death at Rawalpindi, in 1956, only a few preliminary reports have as yet been published.[4]

The expedition was helped by the intelligent and efficient Mr. Ismael Khan, then A.P.O. at Tangir-Darel. He is himself a Shina-speaker, born in the Astor valley, and is deeply interested in the history of his people. During many long hours Friedrich explained to him the aims of anthropology and archaeology. Mr. Ismael Khan told us that in Darel the locals had frequently found gold, bronzes, and ceramics in their fields. When we hurried to Darel, he showed us a place where graves had been opened by the peasants and invited us to make excavations. This was, however, forbidden by an agreement between the Department of Archaeology and the expedition (without the cooperation of a specialist of Pakistan). Moreover, the site had been thoroughly spoiled. Unfortunately, all further investigation had to be stopped because one of my companions fell ill and we had to return to Gilgit.

An invitation of the Austrian Himalaya Society to join the Haramosh Expedition of 1958 enabled me to return to the Gilgit Agency.[5] At Gilgit we met Mr. Ismael Khan, now head of the Village Aid Department. He told me that it was a great pity that we had not been there two years

[1] Biddulph, 1880: 8. Shina belongs to the Dardic group of Indian languages. Southwest of Shinkari was another tribal territory, Indus-Kohistan. The western part of Indus-Kohistan has been governed by the highly efficient ruler of Swat since World War II.

[2] Barth, 1956: 79–86.

[3] Stein, 1928: 1: 10–25. Schomberg, 1935: 272.

[4] Jettmar, 1957*a*; 1957*b*.

[5] The mountaineering team (Dr. Franz Mandl, Stefan Pauer, Dr. Rudolf Hammerschlag and Rudolf Ebner) under the leadership of Heinrich Roess (decd.) conquered the Haramosh peak. The scientific team consisted of the geographer Professor Konrad Wiche, the zoologist Dr. Eduard Pifl and myself as ethnologist. *Cf.* Wiche, 1958.

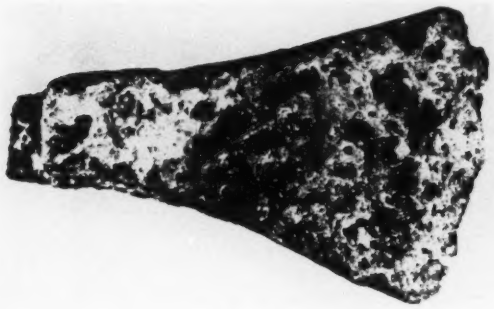


FIG. 1.

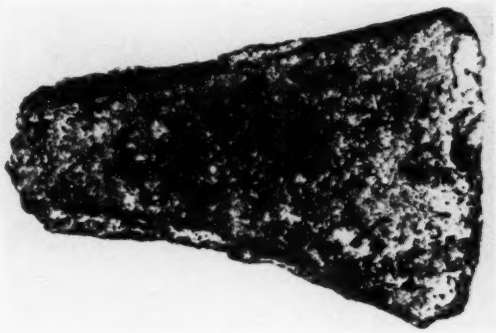


FIG. 3.

before (1956), because a big hoard, mainly of bronzes, had been found at the village of Manikhal in Darel. It consisted of a large number of axes, but there were also big flat spoons and forks, and some rods.

As he had heard so much of archaeology from Professor Friedrich, Ismael Khan saved some pieces and said he had taken them with him when he was transferred to Gilgit. He immediately ordered a servant to bring them. The servant, however, confessed that they had been lost.

A grant from the American Philosophical Society enabled me to revisit Tangir and Darel. On the seventh of July I was again at Shumari, in the Tangir valley, and there the new A.P.O., Mr. Malik Muhammad Azim Khan, told me that some bronzes had been left behind in the house when he replaced Mr. Ismael Khan. They came from Lower Manikhal and apparently belonged to the things missing at Gilgit. The A.P.O. wanted to present them to me. The lot consisted of four heavily patinated axes. They were broken and the necks were lacking, but it was quite clear that they had originally been provided with shaft-holes. Their shape was reminiscent of the modern iron axes used today in the Gilgit Agency, but they were clumsier and made of bronze or copper. Their average thickness was between 2 and 3 cms.

Measurements of the fragments:

	length	breadth (on the cutting edge)
No. 1	17 cms.,	10.7 cms. (fig. 1)
No. 2	16 cms.,	11 cms. (fig. 2)
No. 3	15.5 cms.,	11 cms. (fig. 3)
No. 4	16.8 cms.,	9.7 cms. (fig. 4).

Ten days later we shifted to Shumari, in Darel, and there I tried to obtain further objects from the same site. On the twenty-first of July, Gafur, a man of Lower Manikhal, came and brought me objects nos. 5–7.

No. 5 is a bronze axe apparently almost of the same shape as nos. 1–4, but more slender. There is a break at the shaft-hole, but no part is missing. The flat neck is still intact. The piece looks old, but is not much patinated. Length 20.2 cms., breadth 9.7 cms. (fig. 5).

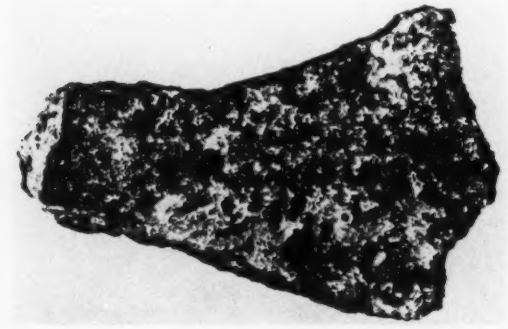


FIG. 2.

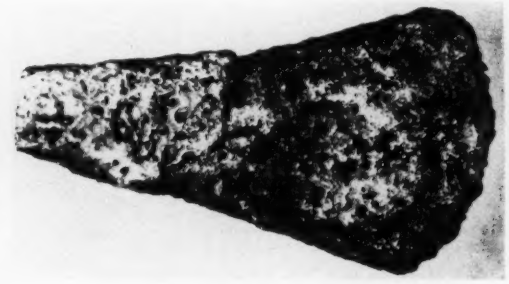


FIG. 4.

FIG. 5.

No. 6 is a narrow axe with a shoulder behind the shaft-hole. The neck is in the shape of an almost round tap. Length 14.3 cms., breadth 5.3 cms. (fig. 6).

No. 7 has almost the same contour as no. 6 but is a flat trunnion celt. Length 14.2 cms., breath 4.6 cms. (fig. 7).

Gafur told me the following story concerning the provenance of these objects:

Near the kot, i.e., the village fortress of Lower Manikhal (Kirinu-Manikhal), a man was repairing his house and made a deep pit. In this pit he found bronzes and pieces of gold. When people ran together and started digging they found copper objects, mainly axes, some vessels made of copper, and golden ornaments and plates. There were no iron objects and no coins. Since Gafur came relatively late he did not get any gold, only the three axes. Most of the copper axes were sold to a merchant at Chilas. The whole lot must have weighed more than a mound, i.e. over 80 pounds.

In this story many points are not clear, especially why the man was making such a pit for a house. The common Dareli house is not subterranean and has no solid foundations.

When we reached Lower Manikhal this problem was solved. The kot lies on a low hill and is easily accessible from three sides. On the fourth side there is a steep slope leading down to the Darel River. As the river gnaws at the foot of the slope, each year big avalanches of stone and gravel go down. In a few decades all the houses which lie just on the rim of the slope will have disappeared. The owner, who wanted to delay this process, cut a step into the slope a few feet below the corner of his homestead in order to build a buttress. In this step he found the objects. When he worked here, plenty of people were around because this place, in spite of the gaping abyss, was used as a latrine by the whole village.

FIG. 7.

Two days later another man appeared and brought a bowl (no. 8) which he pretended to have found at the same spot. It was not patinated but strongly greased and dark, because it had been used as a kitchen pot. It is a bowl of bronze or copper. Beneath the lip there are two circular flutes. There are some traces of a plating made of a light-colored metal (tin?). The piece is quite similar to modern metal vessels still used in the Punjab. Diameter (on the rim) 13.3 cms., height 6 cms. (fig. 8).

I took the objects to Karachi and, conforming to the law, handed them over to the Archaeological Service of Pakistan for the National Museum of Karachi. By courtesy of Mr. Khan, chief of the Department of Archaeology, I got the photographs which are the basis of my description. I hope that further examinations, chemical analysis of the bronze, and perhaps excavations on the site will be made by Pakistan specialists.

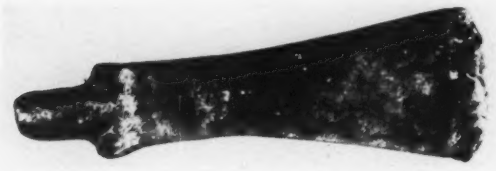


FIG. 6.

FIG. 8.

II

In view of the circumstances of discovery it appears by no means sure that the objects really belong to one complex.

Most dubious is object no. 8 (fig. 8). It was brought to me when there was already a rumor abroad that I would pay for pieces like that. It could be a relatively modern object. Similar bowls made of wood are still used in Eastern Turkestan and in Tibet.

We may be more hopeful as regards the objects nos. 5–7 (figs. 5–7). Any comparable bronzes are missing from modern inventories, and yet nobody would think of making fakes intentionally. But since their patination is quite different from that of nos. 1–4 (figs. 1–4) we may assume that they need not belong to the same hoard, but were perhaps found at some other place in the valley.

The axes nos. 1–4 were collected by the A.P.O. immediately after the discovery of the hoard. As far as I can see, the locals had no prospect of getting paid for them. So there is no reason why they should not have come from the place designated. According to their heavy patination they cannot be modern or even of a relatively recent date.

It is quite possible that there were more bronze or copper objects, but we have not the slightest indication whether we are faced with a place for offerings, or a graveyard for ashes after cremation (the people said that they found "coal"[6]) or a depot. The terminus ante quem is surely given by the time when bronze was replaced by iron the daily use. The Shina word for iron "čimer" (from Burushaski "čhuma'r," *cf.* Turkish "timur," "temir") may indicate its introduction not from India but from Central Asia.[7] Here as attested by Herodotus[8] and by the excavations in the Minussinsk Basin, bronze for weapons and tools were used during the Scythian period,[9] partly side by side with iron. Even in the armories of Achaemenid Persia there were still bronze weapons.[10]

Anyhow, we are justified in summarizing that the objects really date from the Bronze Age or from a period which was still carrying on Bronze Age traditions. At least the likelihood of their doing so is no less strong than with other bronzes found by chance in Pakistan (for instance the famous trunnion celt of Shalozan).[11]

III

In spite of a clay model found at Mohenjo-daro which, according to Piggott, "seems to represent a form of shaft-hole axe," flat copper and bronze axes or adzes were typical of the Harappa civilization. Apparently they were inherited from some early Iranian culture. The perseverance of the form was due to the "inherent conservatism" of India and "partly to the lack of effective contact with Mesopotamia or immediately adjacent Elam."[12]

When, probably in post-Harappa times, shaft-hole axes appeared on the Indian subcontinent, they were very rare and remained like foreigners near the threshold.

One axe was found in Burial B of the Shahi-tump Cemetery in South Baluchistan. It was compared with those from Maikop and Tsarskaia in South Russia.[13]

Another axe was found in the Jhukar levels at Chanhu-daro.[14]

A ceremonial axe with a shaft-hole was found in a burial place at Khurab in Persian Makran not far from the border of Pakistan.[15]

The famous copper axe-adze from Mohenjo-daro may be mentioned, with some reservations. It can be compared to pieces from Hissar III, Shah Tepe, Turang Tepe, Sialk cemetery B[16] (and perhaps also Maikop).[17] A similar object found in Sogdiana[18] has never been mentioned in this connection up till now. A pick-axe from Faskau, in the Vienna Museum of Ethnology, may be a derivative of this type.[19] There is a useful map of the finding places in the paper of Bongard-Levin and Deopik.[20]

[6] Cremation was prevalent in the valley during the pre-Islamic period. *Cf.* Biddulph, 1880: 113/114.

[7] Morgenstierne, 1926: 68.

[8] I/255. Cultural influence from the north is attested by the find of Ishkumān. Stein, 1944: 14–16. Litvinsky, 1960.

[9] Kiselev, 1951: 275.

[10] Schmidt, 1939: 50, fig. 30.

[11] First indicated by Ann. Rep. Archaeol. Survey of India, 1913–1914, reproduced by Heine-Geldern, Lal, and others.

[12] Piggott, 1950: 198–199.

[13] Piggott, 1950: 219, fig. 2*b*; Lal, 1953: 90. Childe has protested, but in fact the difference is not considerable.

[14] Lal, 1953: 90, 89, fig. 2/8.

[15] Gordon, 1954/55: 169, and pl. LXVI.

[16] Piggott, 1950: 228. Heine-Geldern, 1936: 93–94.

[17] Hančar, 1937: 251, pl. XLIII/2, and Heine-Geldern, 1936: 93.

[18] Terenozhkin, 1950. Table between pp. 154–155.

[19] Heine-Geldern, 1936: pl. XVII, fig. 12.

[20] Bongard-Levin, G. M., i D. V. Deopik, 1957: 48/49.

Our axes of Darel fit perfectly into this map, since they, too, were found in the northwestern corner of the subcontinent. The same applies to the trunnion axe (obj. 7, fig. 7). It has only one actual parallel in the Indian subcontinent: the axe found at Shalozan in the Kurram valley.[21] (The Kurram is a tributary of the Indus River, not very far from Darel, just on the border of the subcontinent.) Evidently the pieces are related, but the Darel one is more slender, indicating perhaps a later date. If we look for further relatives we have to go to Western Asia and Europe.

The small shaft-hole axe no. 6 (fig. 6) evidently belongs to a type of western origin. The hammer-shaped neck makes us think of the picks of Achaemenian times.[22] Similar weapons were used in the steppe-belt, e.g. in Minussinsk.[23]

We have already mentioned that the shaft-hole axe (no. 6, fig. 6) and the flat trunnion celt (no. 7, fig. 7) have the same outlines. Corresponding phenomena can occasionally be observed among Caucasian materials, for instance, in the shaft-hole axe of Gagry[24] and the flat celts from the museum at Krasnodar.[25] Obviously, the co-existence of types of flat axes and shaft-hole axes related to one another is common in this western area. The hammer-shaped neck appears there in the last centuries of the second millennium.

Summing up, we may say that all the Darel axes have definite western, possibly Caucasian, affinities. It is somewhat surprising that in a forlorn valley of the Karakoram more shaft-hole axes of bronze have been found than were ever discovered in the soil of the Indian subcontinent.

IV

In this connection, I may be allowed to point out that the pre-Islamic spiritual inheritance of the Dardic peoples differs in many respects from that of the other Indo-Aryan groups and has peculiar affinities to the traditions of the highlanders of Western Asia, in Anatolia, the Zagros mountains, and particularly in the Caucasus.[26]

The holy animal of the Dards is not the cow, but the wild as well as the domestic goat, i.e., the holy animals of the Luristan bronzes. We meet with a special correspondence between goat and tree, as depicted in so many West Asiatic seals.

The chief female deity of the Dards, the Murkum, not only gives easy childbirth to the womenfolk like Artemis, but she is also the owner of all wild animals, especially the ibex and markhor. Her residence is on the top of the highest mountain. She can restore to life animals killed and eaten up by putting their bones together. If there is a rib or any other bone lacking, she will replace it by a twig or wooden stick.

This conception is rooted in a special kind of hunting-magic which is widely distributed in time and space.[27] But the nearest parallel can be found in Caucasian lore. Even the characteristic trait of the missing rib is present.[28] It was presumably from the Causasus that this motif came into the tales of the Alps.[29]

In modern Karakoram the axe is still a highly venerated instrument used in religious ceremonies by the pagan Kalash-Kafirs. Only ideas like these can explain the amazing evolution, rich in fancy, which the axe underwent in Prehistoric Caucasia.

From the linguistic point of view it must be said that only one part of the Dardic vocabulary is Indo-Aryan. Some roots of the rest can be explained by Burushaski, but others are still obscur.[30] The Dards certainly contain a considerable alien element of unknown origin.

I think when we have an anthropologic analysis of the Dards, we shall see that their nearest relatives are not other Indian peoples but the mountain folk of Western Asia.

When I came to the conclusion that so many Caucasians or, at least, West Asiatic traits were included in the old Dardic pattern, I was not able to say in what way and at what time they were imported. Now there is at least a faint possibility that they were brought by the same wave of men and ideas which carried the shaft-hole axe and the trunnion celt into the borders of the Northwest Frontier Province. As Heine-Geldern

[21] Heine-Geldern, 1936: 87; 1956: 137; Lal, 1953: 90, fig. 4.

[22] E. F. Schmidt, 1939: 49, fig. 14 and 30.

[23] Kiselev, 1951: 241, pl. XXIV.

[24] Iessen, 1951: 81, fig. 3. Among Chinese Ko-weapons as well.

[25] Iessen, 1951: 63, fig. 22.

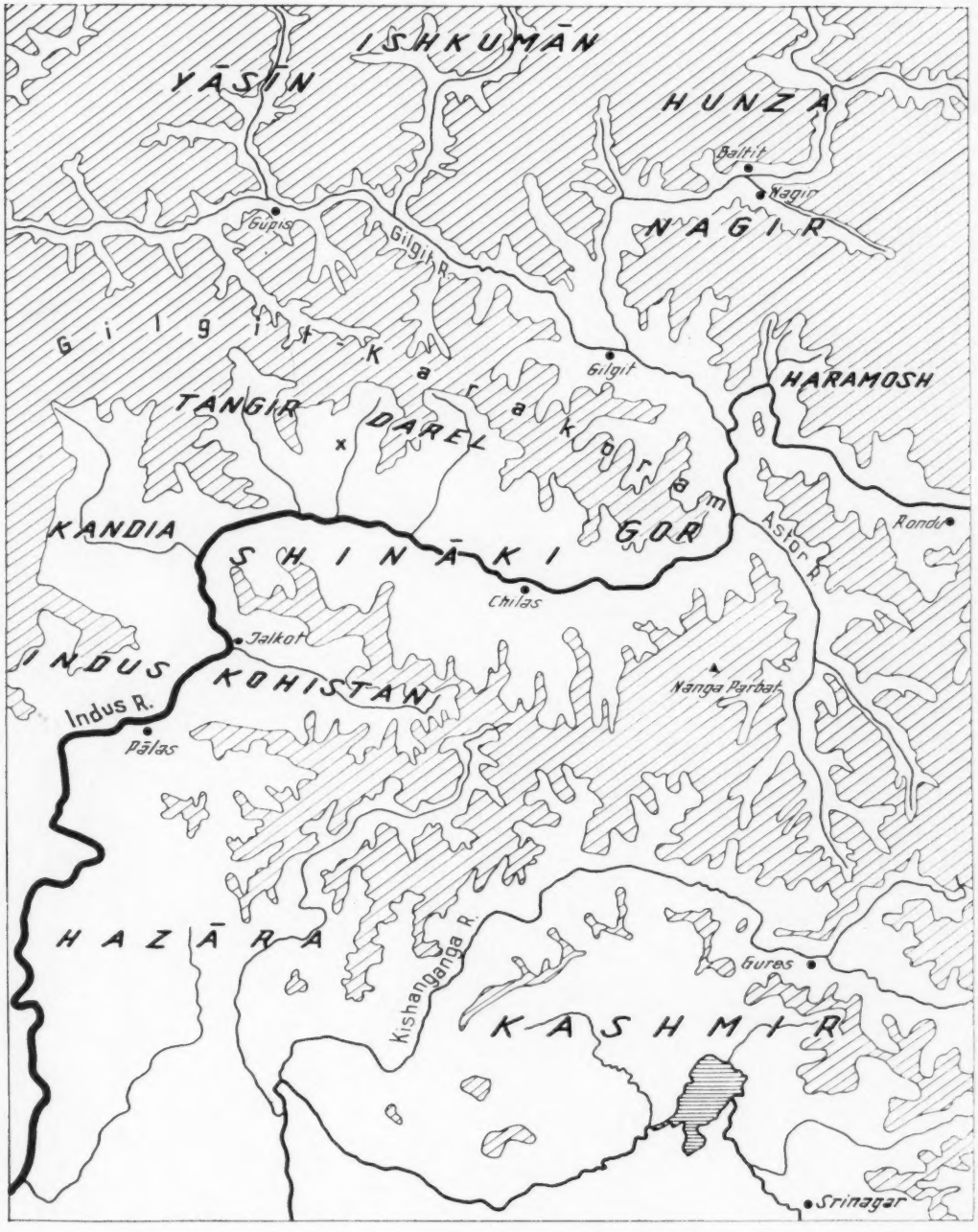
[26] Jettmar, 1957*a* and 1957*b*, 1958*a*, and 1958*b*.

[27] Friedrich, 1943: 193–218; Nachtigall, 1952; Meuli, 1946. Beninger observed this connection already in 1934. *Cf.* Beninger, 1958/59: 80.

[28] Dirr, 1925: 140–143.

[29] L. Schmidt, 1952: 520–524. Finally it reached the Germanic peoples of Scandinavia.

[30] Morgenstierne, 1932: 48. Burushaski is an enigmatic language unrelated to any of the great families and spoken today only in the most inaccessible valleys of the Karakoram (Yasin and Hunza). *Cf.* Lorimer, 1955*a* and 1935*b*. Lorimer, 1938.



MAP 1. Main area of the Shina language and adjacent regions. X denotes site of the hoard. /////// denotes altitude over 2,500 meters.

pointed out tribes of Caucasian origin may have joined the Aryans in their migration to India.[31]

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[31] Heine-Geldern, 1956: 139. For other explanations see my second article in this book.

BASIC DATA ON THE EMERGENCE OF PERMANENT TEETH IN THE RHESUS MONKEY (*MACACA MULATTA*)[1]

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INTRODUCTION

THE anatomical resemblance between the dental organs of man and other primates has led to much speculation with regard to possible points of similarity in their growth, development, function, and dysfunction. Interest in the monkey stems naturally from the desire to find a laboratory animal that might furnish the biologist with material which would lead to a better understanding of what has been called, most appropriately, the dentofacial *complex* of man. It need not be stressed that in comparative studies involving man a diphyodont mammal has many obvious advantages over a monophyodont one, such as the rat (35).[2]

In a paper published in these *Proceedings* in 1953 (16) the authors described their work using extensive original data bearing on the subject of emergence of deciduous teeth in the mulatta macaque, popularly known as the rhesus monkey (*Macaca mulatta*) (23) (44). A shorter report (17) released three years later should be looked upon as merely a supplement to the 1953 article, adding certain details lacking from the latter and linking the study of the period of emergence of deciduous teeth with that of the first members of the permanent dentition, i.e., the permanent first molars. However, since any discussion of odontiasis in a diphyodont animal is incomplete unless it covers both the deciduous and succedaneous phases of the phenomenon, it is evident that the present paper actually constitutes the second major component of this series of articles.

The difficulties in securing adequate first-hand data for attempting a biometric analysis of permanent tooth eruption far surpass those attendant upon a like analysis of the deciduous teeth. While the minimum number of animals needed for such a study is not large from a statistician's point of view, it is, nevertheless, far greater than can be supplied by most animal laboratories in the world today.

The basic data for the present report, as for the previous studies, were compiled in the Department of Obstetrics and Gynecology at the Yale University School of Medicine utilizing a colony of monkeys which has now been in existence over twenty-five years. It may be of interest to record the fact that, leaving out the great apes and the gibbons, there are in the world today, to the knowledge of the authors, only four other primate laboratories with a sufficient number of living animals to permit researches comparable with the present one.

One of these, the Medical Biological Station of the Academy of Medical Sciences, U.S.S.R., established in 1927, is located at Sukhumi, Abkhazia, Georgian S.S.R. No large-scale odontological investigations appear to have been conducted at this well-equipped station, judging from a recent publication (38), but some data on the deciduous teeth of mulatta macaques and of hamadryas baboons have been released (19) (20).

South Africa is the site of two noteworthy primate laboratories. Professor R. A. Dart, in 1924, established a colony of chacma baboons (*Papio ursinus*) at the University of the Witwatersrand, in Johannesburg. The colony has increased steadily, numbering about eighty animals today (6). Currently Dr. L. Freedman is observing them for the purpose of establishing the ages of eruption of both deciduous and permanent teeth (6) (12). Another primate laboratory, near Pretoria, is of relatively recent origin; the data on the vervet monkey, on page 134 and in table 19, were obtained from this source (26) (27) (28).

No dental observations have been reported on the large colony of a subspecies of anubis (*Papio doguera*) in the San Antonio Zoo, in Texas, where F. Stark has "line-bred" these East African catarrhines since 1937 (41).

[1] This investigation was supported by research grant C-2304 from the Cancer Institute, Public Health Service.

[2] Numbers in parentheses indicate references at end of article.

TABLE 1

AGES AT EMERGENCE OF PERMANENT MAXILLARY TEETH IN 31 NORMAL MALE MONKEYS ARRANGED IN APPROXIMATE RANK ORDER

Third molar values ignored in establishing sequence
Order of bracketed numbers more or less indeterminable
Data expressed to the nearest hundredth of a year

Dentition number of animal	Teeth															
	M_1		I_1		I_2		M_2		Pm_1		Pm_2		C		M_3	
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
28	1.19	1.17														
66	1.28	1.28	2.12													
57	1.30	1.30														
24	1.33	1.31														
12	1.32	1.32	2.17	2.36	2.42	2.46										
51	1.54	1.54	2.19	2.19	2.44	2.53										
40			2.30	2.30												
65	1.21	1.22	2.38	2.38	2.46	2.46	2.96	2.96	3.29	3.37	3.37	3.37	3.60	3.60		
[41	1.40	1.40	2.38	2.38	2.63	2.71										
20]	1.47	1.47	2.11	2.19	2.52	2.59	3.19	3.19	3.19	3.19	3.61	3.70	4.60	4.51	5.18	5.18
33	1.49	1.49														
11	1.47	1.47	2.20	2.20	2.49	2.58	3.43	3.43	3.68	3.64	3.59	3.59	4.08	4.08		
62	1.37	1.37	2.54	2.49												
1	1.53	1.53	2.20	2.20	2.54	2.37	3.21	3.10							5.13	5.32
[56	1.28	1.28	2.46	2.46	2.54	2.69	3.05	3.05	3.82	3.54	3.82	3.54	4.16	4.05	5.45	5.55
15	1.53	1.53	2.52	2.59	2.77	2.77	3.26	3.26	3.34	3.34	3.59					
38]	1.48	1.42	2.68	2.68	2.83	2.80	3.29	3.04	3.55	3.29	3.79	3.37	4.21	4.21	5.63	5.04
14	1.50	1.52														
64	1.38	1.38	2.54	2.54	2.88	2.80	3.29	3.29	4.09	3.81	3.81	3.81	3.89	3.89	5.47	5.47
[63	1.35	1.35	2.69	2.69	2.86	2.86	3.61	3.61	3.74	3.74	3.61					
4	1.52	1.52	2.52	2.52												
19	1.42	1.52	2.73	2.81	3.06	3.06	3.14	3.14	3.23	3.23	3.94	3.98	4.23	4.32	5.23	5.23
60]	1.63	1.63	2.38	2.13	2.93	2.93	3.47	3.47	3.72	3.88	3.72	3.88		4.16		
8	1.92	1.90	2.56	2.56	2.71	2.71	3.38	3.38	3.24	3.34		3.53	4.61	4.56	5.55	5.64
[54	1.61	1.61	2.62	2.70	3.03	2.95	3.45	3.45	4.29	4.29	4.37	4.29	4.54	4.45	6.29	6.45
7	1.63	1.63	2.60	2.73	2.77	2.85	3.52	3.59	4.53	3.73	*	4.02	4.35	4.61	5.93	5.86
49]	1.62	1.71	2.62	2.62	2.87	2.87										
9	1.67	1.71	2.64	2.64	3.15	3.21	3.57	3.57	3.98	4.15	3.57	4.15	4.15	4.15		
61	1.61	1.71	2.70	2.80	2.91	2.91	3.47	3.47	3.95	4.04	4.04	3.95	4.21	4.21	8.40	>8.40
3	1.79	1.83	2.77	2.93	2.98	3.09	3.60	3.70	3.53	4.03	3.70	4.03	4.17	4.37		
10	1.71	1.71	2.94	3.02	3.21	3.21	3.59	3.69	3.91	4.05	4.18	4.18	4.22	4.26		

* Agenesis.

Whereas less than nine months are required for obtaining a complete serial record on the emergence of deciduous teeth in a normal infant macaque with a slow rate of maturation, and not over four months in the case of a rapidly developing animal, the different anatomical units comprising the permanent dentition demand a period of *continuous observation of from three and a half to about ten years.* Not many investigators are interested in long-term studies of the normal physiological functions of the monkey as in short-term projects. This means, of course, that rather limited numbers of animals ever reach full adulthood under conditions suitable for making observations on the uninterrupted growth and development of different parts of the body, most of them being deliberately sacrificed long before their dentition has been completed.

In addition to the above, it is a fact that the expense of conducting researches on the life cycle of any species of primates is more than most laboratories can bear. It is not easy to secure funds for two or more decades of admittedly prosaic work centering on large groups of healthy animals. Some concept of the economic aspects of investigations dealing with normal adult simians

TABLE 2

AGES AT EMERGENCE OF PERMANENT MANDIBULAR TEETH IN 31 NORMAL MALE MONKEYS ARRANGED IN APPROXIMATE RANK ORDER

Third molar values ignored in establishing sequence
Order of bracketed numbers more or less indeterminable
Data expressed to the nearest hundredth of a year

Dentition number of animal	Teeth															
	M_1		I_1		I_2		M_2		Pm_3		Pm_4		C		M_3	
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
28	1.08	1.04	...	...	...	...	...	...	...	...	...	...	...	...	...	...
66	1.05	1.05	...	...	...	...	...	...	...	...	...	...	...	...	...	...
57	1.16	1.16	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	1.18	1.18	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	1.20	1.17	2.15	2.15	2.36	2.36	...	...	...	...	...	...	...	...	...	...
51	1.29	1.36	1.77	2.06	2.36	2.19	...	...	...	...	...	...	...	...	...	...
40	...	...	2.23	2.23	...	...	...	...	...	...	...	...	...	...	...	...
65	1.13	1.13	2.38	2.38	2.46	2.46	2.80	2.80	3.37	3.37	3.37	3.37	3.60	3.60	5.25	5.25
[41	1.28	1.32	2.21	2.21	2.38	2.38	2.96	2.96	...	...	...	...	...	...	...	...
20]	1.36	1.36	2.19	2.19	2.46	2.34	3.19	3.19	3.70	3.61	3.76	3.76	4.51	4.15	5.11	5.11
33	1.37	1.37	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11	1.41	1.41	2.20	2.20	2.33	2.30	3.26	3.26	3.68	3.59	3.76	3.76	3.80	3.76	5.67	5.42
62	1.30	1.30	2.32	2.32	2.44	2.37	...	...	...	...	...	...	...	...	...	...
1	1.60	1.44	2.20	2.20	2.29	2.29	3.21	3.10	...	...	...	...	...	...	5.61	5.53
[56	1.26	1.26	2.63	2.63	2.63	2.70	2.80	2.80	3.96	4.05	3.96	3.96	3.96	3.96	4.94	5.22
15	1.38	1.38	2.44	2.44	2.35	2.35	3.02	3.02	3.26	3.34	3.59	3.69	...	...	...	...
38]	1.32	1.32	2.50	2.50	2.50	2.50	3.12	3.20	3.71	3.71	3.87	3.87	3.87	3.87	5.42	5.29
14	1.43	1.43	...	...	...	...	...	...	...	...	...	...	...	...	...	...
64	1.28	1.38	2.44	2.44	2.80	2.96	3.21	3.21	3.62	3.81	3.81	3.81	4.09	4.09	5.47	5.47
[63	1.23	1.23	2.61	2.61	2.61	2.61	3.35	3.35	3.74	3.84	3.74	3.84	...	...	...	...
4	1.42	1.44	2.48	2.37	2.52	2.40	...	...	...	...	...	...	...	...	...	...
19	1.27	1.27	2.50	2.50	2.58	2.50	3.06	3.06	3.46	3.38	3.81	3.56	4.32	4.32	5.32	5.32
60]	1.38	1.38	2.38	2.38	2.70	2.70	3.13	3.05	3.88	3.88	3.98	3.98	...	...	...	...
8	1.90	1.90	2.38	2.46	2.56	2.56	3.30	3.23	3.63	3.63	...	...	...	...	5.55	5.64
[54	1.36	1.36	2.42	2.53	2.78	2.86	3.28	3.28	4.14	4.14	4.14	4.14	4.14	4.00	5.85	5.85
7	1.63	1.55	2.52	2.52	2.69	2.60	3.43	3.52	4.17	4.17	4.17	4.14	4.11	4.07	5.43	5.43
49]	1.47	1.47	2.54	2.54	2.74	2.62	...	...	...	...	...	...	...	...	...	...
9	1.55	1.60	2.64	2.64	2.64	2.64	3.40	3.40	3.73	4.15	4.02	3.73	3.82	3.86	...	...
61	1.54	1.54	2.70	2.70	2.80	2.80	3.12	3.28	4.13	3.88	3.88	3.88	3.95	3.95	6.65	6.93
3	1.52	1.56	2.93	2.93	2.85	2.85	3.35	3.43	3.70	4.03	4.22	4.07	4.11	4.07	...	...
10	1.51	1.51	2.63	2.75	3.39	3.02	3.34	3.43	4.01	4.18	4.01	4.01	4.09	4.01	...	...

may be formed by considering that the expense of maintaining a baby macaque until one year of age is not much less than the cost of supporting a human infant for an equal length of time in an average American home.

The realities already alluded to do not exhaust the listing of major obstacles which stand in the way of comparative studies of odontiasis in man and other primates. Elucidation of sex differences presents other problems to the biometrician, because there are, at best, very limited data available on full-grown male monkeys—not enough for statistical manipulation by conventional methods. One reason for this is that for successful breeding of even a large colony only a few healthy males are needed. Other difficulties are due to the fact that a vigorous adult male monkey is a dangerous beast, who can inflict lacerating wounds on anyone who tries to inspect his formidable dentition at close range, so that even highly experienced technicians are unwilling to handle him oftener than is absolutely necessary. Unfortunately, it is not wise to subject these animals to general anesthesia frequently over a period extending to as much as a quarter or a third of their life span. This makes for wider spacing of dental examinations and a loss of refinement in their interpretation.

TABLE 3

AGES AT EMERGENCE OF PERMANENT MAXILLARY TEETH IN 42 NORMAL FEMALE MONKEYS
ARRANGED IN APPROXIMATE RANK ORDER

Third molar values ignored in establishing sequence
Position of numbers within parentheses most open to question
Data expressed to the nearest hundredth of a year

Dentition number of animal	Teeth															
	M_1		I_1		I_2		M_2		Pm_3		C		Pm_4		M_3	
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
10	1.28	1.35	2.04	1.98	2.51	2.59	2.93	2.93	3.29	3.01	3.10	3.10	3.18	2.93	5.67	5.76
9	1.39	1.33	2.26	2.11	2.51	2.51	2.93	3.01	2.93	3.01	3.10	3.10	3.18	3.10	5.59	5.42
69	1.35	1.35	2.28	2.43	2.43	2.43	3.10	3.03	3.03	3.10	3.10	3.10	. .	. .	. .	. .
56	1.34	1.41	2.37	2.30	2.50	2.34	3.13	3.13	2.97	3.37	2.97	3.20	3.20	3.54	5.62	7.21
29	1.32	1.32	2.31	2.31	2.58	2.58	3.11	3.19	3.15	3.19	3.19	3.19	3.36	3.26	6.12	6.12
8	1.40	1.40	2.50	2.50	2.79	2.64	2.94	2.94	3.10	3.17	3.22	3.27	3.17	3.17	5.26	5.26
50	1.29	1.29	2.50	2.60	2.65	2.65	3.10	3.10	2.92	3.34	3.21	3.38	3.17	3.12	4.91	5.58
53	1.32	1.30	2.40	2.40	2.48	2.48	3.32	3.32	3.23	3.23	3.40	3.32	3.40	3.32	. .	10.09
68	1.27	1.29	2.37	2.37	2.54	2.54	2.97	3.05	3.26	3.26	3.26	3.26	3.45	3.37	6.48	6.37
38	1.36	1.36	2.35	2.35	2.49	2.54	3.12	3.17	3.31	3.28	3.44	3.34	3.44	3.44	6.27	6.27
39	1.28	1.32	2.42	2.48	2.65	2.65	3.32	3.32	3.32	3.40	3.40	3.40	3.57	3.65	6.23	6.23
61	1.37	1.37	2.53	2.53	2.66	2.61	3.28	3.23	3.23	3.23	3.53	3.53	3.36	3.36	. .	. .
45	1.32	1.32	2.44	2.44	2.59	2.67	3.36	3.43	3.51	3.43	3.68	3.68	3.68	3.51	10.87	10.11
(31)	1.29	1.40	2.57	2.33	2.73	2.64	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
30	1.42	1.44	2.39	2.33	2.49	2.49	3.31	3.50	3.22	3.50	3.22	3.40	*	3.91	6.80	6.80
17	1.39	1.41	2.14	2.51	2.51	2.76	3.24	3.24	3.43	3.51	3.37	3.76	3.85	3.93	5.92	5.92
4	1.49	1.47	2.36	2.51	2.63	2.71	3.25	3.25	3.34	3.34	3.34	3.34	3.42	3.51	5.93	5.76
73	1.38	1.38	2.54	2.46	2.66	2.80	3.07	3.21	3.32	3.38	. .	. .	. .	. .	. .	. .
57	1.46	1.56	2.42	2.47	2.68	2.68	3.05	3.10	3.27	3.27	4.26	4.34	3.96	3.57	5.59	5.59
2	1.32	1.32	2.45	2.45	2.61	2.61	3.28	3.28	3.51	3.34	3.17	3.28	3.61	3.51	5.52	5.60
(14)	1.56	1.56	2.37	2.37	2.42	2.47	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
36	1.40	1.40	2.52	2.52	2.92	2.61	3.42	3.51	3.36	3.36	3.51	3.51	3.51	3.51	6.50	6.50
16	1.54	1.56	2.54	2.62	2.58	2.66	3.40	3.40	3.12	3.12	3.27	3.27	. .	4.53	6.45	6.45
22	1.47	1.49	2.54	2.54	2.61	2.58	3.28	3.36	3.28	3.24	3.43	3.43	4.69	4.19	7.43	7.45
44	1.35	1.35	2.40	2.40	3.07	3.07	3.41	3.41	3.49	3.66	3.66	3.74	3.83	3.74	6.65	6.41
6	1.54	1.54	2.49	2.49	2.74	2.74	3.49	3.49	3.39	3.39	3.25	3.25	3.66	3.66	6.75	6.40
24	1.66	1.66	2.43	2.55	2.92	2.92	3.46	3.46	3.23	3.23	3.30	3.55	3.23	3.23	6.64	6.29
62	1.37	1.37	2.51	2.47	3.05	3.05	3.46	3.29	3.62	3.46	3.71	3.62	3.97	3.97	5.88	5.88
5	1.58	1.56	2.71	2.64	2.91	2.87	3.51	3.41	2.76	3.08	3.33	3.33	3.72	3.41	. .	. .
21	1.49	1.49	2.69	2.76	2.93	2.93	3.43	3.43	3.43	3.43	3.80	3.72	3.67	3.67	6.44	6.44
(3)	1.52	1.56	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
19	1.50	1.50	2.60	2.51	2.85	2.68	3.60	3.60	3.56	3.60	3.60	3.60	3.69	3.76	7.09	7.09
70	1.49	1.49	2.71	2.71	3.15	3.15	3.40	3.47	3.54	3.47	3.65	3.54	3.54	3.47	. .	. .
23	1.53	1.49	2.91	2.76	3.09	3.18	3.33	3.26	3.51	3.51	3.76	3.68	4.20	3.76	6.02	6.19
20	1.42	1.40	2.67	2.67	3.17	3.17	3.42	3.26	3.83	3.54	4.24	4.01	4.01	4.09	6.42	6.26
11	1.61	1.61	2.79	2.79	3.06	2.96	3.88	4.05	3.97	4.01	3.42	3.46	4.30	4.18	7.71	7.79
72	1.55	1.63	2.55	2.46	3.05	3.05	3.98	3.79	4.80	4.07	4.56	4.46	4.56	4.23	7.38†	6.72†
15	1.62	1.60	2.62	2.55	2.85	2.91	3.91	3.77	3.62	3.62	4.61	5.12	4.38	4.29	. .	. .
71	1.55	1.55	2.71	2.79	3.05	2.96	3.57	3.63	3.98	4.05	5.05	4.97	4.21	4.80	7.29†	7.17†
12	1.64	1.64	2.70	2.86	2.95	3.00	3.87	3.95	4.05	4.05	4.00	3.95	4.23	4.26	7.88	8.53
34	1.53	1.55	3.07	3.07	3.24	3.24	3.64	3.64	3.89	3.97	3.97	3.97	4.24	4.07	5.06	5.06
13	1.65	1.67	3.00	3.00	3.12	3.12	3.75	3.82	3.75	3.82	3.92	3.92	4.34	4.25	6.49	6.58

* Agenesis.

† Datum secured too late for inclusion in analyses.

TABLE 4

AGES AT EMERGENCE OF PERMANENT MANDIBULAR TEETH IN 42 NORMAL FEMALE MONKEYS ARRANGED IN APPROXIMATE RANK ORDER

Third molar values ignored in establishing sequence
Position of numbers within parentheses most open to question
Data expressed to the nearest hundredth of a year

Dentition number of animal	Teeth															
	M_1		I_1		I_2		M_2		C		Pm_1		Pm_2		M_3	
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
10	1.24	1.24	2.41	2.36	2.36	2.26	2.83	2.76	2.68	2.51	2.72	2.83	3.01	3.06	5.50	5.34
9	1.25	1.23	2.36	2.36	2.36	2.36	2.76	2.68	2.83	2.83	2.68	3.01	2.59	3.10	5.00	4.85
69	1.23	1.23	2.12	2.12	2.18	2.18	2.76	2.68	2.76	2.68	3.18	3.18	...	...	...	...
56	1.34	1.34	2.13	2.20	2.30	2.37	2.88	3.07	2.67	2.88	3.07	3.20	3.07	3.37	5.20	5.98
29	1.32	1.32	2.31	2.31	2.19	2.19	2.94	2.94	2.78	2.78	3.11	3.19	3.19	3.19	5.85	5.85
8	1.19	1.15	2.34	2.42	2.42	2.42	2.68	2.68	2.94	2.94	3.10	3.10	3.10	3.10	4.88	4.74
50	1.29	1.27	2.25	2.25	2.42	2.42	2.75	2.92	2.79	3.10	2.70	3.25	3.10	4.02	4.91	5.41
53	1.27	1.23	2.32	2.40	2.40	2.40	3.15	3.08	2.90	2.80	3.08	3.08	3.23	3.15	6.29	6.29
68	1.27	1.27	2.46	2.46	2.46	2.46	2.87	2.87	3.01	3.26	3.01	3.31	3.81	3.31	5.87	5.87
38	1.21	1.32	2.25	2.35	2.44	2.35	3.12	3.02	3.02	3.02	3.34	3.44	3.34	3.28	5.83	5.83
39	1.15	1.21	2.42	2.32	2.48	2.48	3.00	3.17	3.06	3.00	3.32	3.23	3.57	3.82	5.49	5.49
61	1.26	1.26	2.53	2.53	2.61	2.61	3.03	3.03	3.11	3.11	3.23	3.23	3.23	3.23	...	...
45	1.22	1.22	2.19	2.27	2.77	2.44	3.09	3.19	3.02	3.19	3.61	3.26	3.51	3.51	6.68	6.68
(31)	1.27	1.27	2.14	2.14	2.39	2.33	3.06	3.31	...	...	...	...	...	...	...	...
30	1.31	1.31	2.33	2.33	2.33	2.39	3.22	3.31	3.06	3.22	3.31	3.31	3.50	3.73	6.57	6.57
17	1.32	1.32	2.38	2.43	2.38	2.51	3.01	3.01	3.01	3.01	3.37	3.37	3.60	3.85	5.50	5.50
4	1.37	1.37	2.47	2.42	2.59	2.59	3.08	3.08	3.19	3.19	3.42	3.42	3.42	3.42	5.11	5.11
73	1.29	1.29	2.38	2.38	2.54	2.46	3.07	3.07	3.21	3.21	3.38	3.32	...	...	...	...
57	1.46	1.38	2.35	2.42	2.42	2.35	3.05	2.94	3.08	2.94	3.52	3.27	3.84	3.42	5.95	5.68
2	1.24	1.20	2.69	2.69	2.69	2.69	3.28	3.28	3.07	3.43	3.34	3.43	3.51	3.51	5.39	5.39
(14)	1.50	1.50	2.37	2.37	2.37	2.47	...	...	...	...	...	...	...	...	...	...
36	1.26	1.25	2.42	2.32	2.52	2.61	3.25	3.19	3.36	3.36	3.36	3.36	3.51	3.51	5.68	5.68
16	1.40	1.40	2.41	2.41	2.41	2.41	3.21	3.27	3.04	3.12	3.21	3.21	3.12	3.12	5.53	5.47
22	1.34	1.34	2.31	2.31	2.54	2.54	3.11	3.11	3.11	3.28	3.19	3.19	3.19	3.11	6.85	6.85
44	1.20	1.18	2.40	2.40	2.40	2.40	3.24	3.24	2.98	2.98	3.49	3.49	3.49	3.49	5.81	5.91
6	1.37	1.37	2.40	2.34	2.57	2.65	3.39	3.32	2.82	2.78	3.49	3.39	3.57	3.57	6.40	6.08
24	1.45	1.40	2.38	2.55	2.80	2.80	3.38	3.38	3.23	3.23	3.13	3.23	3.13	3.23	6.54	6.47
62	1.21	1.21	2.31	2.47	3.09	2.97	3.29	3.22	3.05	3.22	3.71	3.46	3.87	3.87	5.40	5.40
5	1.41	1.44	2.60	2.66	3.01	2.91	3.18	3.18	3.01	3.07	3.59	3.41	3.68	3.76	...	...
21	1.37	1.37	2.59	2.69	2.55	2.69	3.17	3.09	3.17	3.26	3.34	3.34	3.43	3.43	5.70	5.60
(3)	1.39	1.43	...	...	2.69	2.69	...	...	...	...	...	...	...	...	...	...
19	1.37	1.37	2.35	2.35	2.51	2.47	3.44	3.27	3.35	3.35	3.77	3.85	3.77	3.69	6.36	6.36
70	1.22	1.29	2.54	2.54	2.65	2.71	3.15	3.29	3.29	3.29	3.47	3.47	3.54	3.65	7.55†	8.71†
23	1.31	1.31	2.76	2.76	2.59	2.79	3.01	3.01	3.51	3.33	3.51	3.51	3.58	3.68	5.35	5.25
20	1.24	1.24	2.67	2.67	2.67	2.67	3.03	3.03	3.33	3.33	4.01	3.67	4.01	3.67	5.91	5.91
11	1.48	1.46	2.79	2.79	2.96	2.88	3.71	3.63	3.38	3.30	3.63	3.63	4.05	4.05	6.32	6.37
72	1.41	1.41	2.79	2.55	2.96	2.79	3.38	3.38	3.88	4.07	3.79	3.79	3.98	3.98	6.97†	6.55†
15	1.56	1.56	2.45	2.55	2.79	2.62	3.71	3.62	3.91	4.29	4.14	3.96	4.61	4.29	...	...
71	1.41	1.41	2.79	2.63	3.98	3.32	3.32	3.32	3.38	3.88	3.79	3.79	3.98	**	6.46†	6.46†
12	1.33	1.37	2.95	3.45	3.05	3.05	3.37	3.45	3.95	3.77	3.95	3.87	4.23	4.23	7.37	7.62
34	1.39	1.38	3.07	2.98	3.11	3.03	3.47	3.47	3.89	3.82	4.24	4.07	4.68	3.64	5.73	5.66
13	1.48	1.48	3.00	3.00	3.40	3.25	3.57	3.57	3.50	3.57	4.25	4.11	4.34	4.11	5.83	5.83

† Datum secured too late for inclusion in analyses.
** Not emerged at 9.37 yrs.

DEFINITION OF EMERGENCE AND MATERIAL STUDIED

Since the aim of the study was to secure information on the timing of the earliest stages of supragingival eruption, the dentition of each monkey was examined as often as was practicable. It was not possible to do this daily, or even weekly, as had been done in dealing with the deciduous phase of odontiasis. Instead, the teeth were inspected monthly, with few exceptions, and a high degree of uniformity in the recording of observations was obtained since one and the same individual[3] was responsible for all details pertaining to this important aspect of the study. All males could not be examined regularly every month when third molar emergence was expected.

A tooth was counted as present as soon as any part of its crown had come into view, *emergence in this paper being defined as the stage of eruption which begins with the initial piercing of the gum by an occlusally moving tooth and which comes to an indefinite end when one-quarter or one-third of the height of the anatomical crown has become exposed.*

It was realized that the eruptive process continues with ever-decreasing and as yet unpredictable velocity as long as an organism is alive. Therefore, to speak of the time of eruption of a given tooth is to use a very broad term, which needs qualification for scientific purposes. Attempts to gain definiteness by using such criteria as "full eruption," or "reaching the occlusal plane," were considered too arbitrary to be of much value.

As previously, the investigation was confined to observations on animals that were healthy and vigorous. Monkeys receiving hormones of any kind, such as testosterone propionate (39), or subjected to surgical alteration, such as castration or gland transplantation, were excluded, as were irradiated animals. Also left out of the normal series are a few specimens which were not on the complete laboratory diet that had been found adequate for satisfactory growth and development.

One male macaque suffered from severe Vincent's infection during the later stages of odontiasis; the dental record (dentition no. 1) covering the time of illness was not considered representative of health and this portion of the record was not included in the series analyzed later.

[3] Mr. Joseph Negri, Assistant in Research, has conducted all laboratory examinations of teeth since breeding for replacement in the colony was begun in 1935.

Before utilizing the emergence records for biometric analyses, allowance was made for the inaccuracies in calculated ages that result from four-week intervals between the majority of examinations of the permanent dentition. It is not possible to learn from the notations made by the research assistant whether a tooth marked "present" for the first time actually came into view 29 days earlier, or only a day prior to the date of examination. For this reason half a month, or 0.04 of a year, was subtracted from most age figures converted into decimals of a year. If the laboratory records indicated different intervals between examinations, the corrections were modified accordingly.

Complete data on all permanent teeth were obtained on 8 males and 32 females out of a total of 73 macaques under observation, but there were many nearly complete records, particularly for males, as can be seen by looking at tables 1 to 4. These tables present the accumulated emergence ages, corrected according to the procedure described in the preceding paragraph. All analyses that follow are based on the material in these tables. The exact numbers of teeth studied are given in the third and fourth columns of tables 6 and 14.

ANALYSES BY RELATIVELY DIRECT METHODS

In so far as was possible, conventional methods of biometric analysis were followed. There were enough data on all classes of permanent teeth in females to permit the utilization of procedures described previously (16) (17), and this was also true of the permanent first molars of males. However, unlike in the study of deciduous teeth, the emergence ages for right and left teeth were not averaged, as there were many instances of marked chronological asymmetry in the development of the permanent teeth.

After arranging the available statistical information on a given class of teeth in an orderly sequence—disregarding laterality—cumulative percentages were computed for the age levels furnished by the material. These were then plotted on graph paper, after which ogive "regression" lines were fitted to the zones formed by the plotted points, following the technique described in detail in the first paper (16).

The percentiles of age distribution of emerging teeth in females, shown in table 5, were obtained without difficulty from the cumulative frequency curves just mentioned. The distinct positive skew-

ing of all frequency distributions can be noted readily by comparing the intervals between various medians and the percentiles above and below them. The pronounced increase in variability that accompanies maturing and aging is brought out clearly by the figures in the last column of this table.

The seventh and eighth columns of table 6 give the means and sigmas derived from frequency distributions based on the aforementioned smoothed curves. In performing the necessary calculations, intervals of one-tenth of a year were found convenient. Table 6 supplies also the means and sigmas obtained more directly, i.e., without recourse to an initial summarization of data by means of the smoothed ogive.

By placing the two sets of statistical figures side by side, it becomes obvious at a glance that the more popular method of computation yields values that are without exception somewhat higher than those obtained by the less direct procedure. Apparently the utilization of the free-hand ogive, as an aid for the mathematical description of variation in emergence ages as revealed by the original observations, minimizes the statistical importance of the few isolated extreme values which are found and which, parenthetically, are open to suspicion as regards the appropriateness of including them without any question among examples of normal dental development. It is noteworthy that most of the lone deviants are from the upper extremes of the ranges of variation; a comparison of the two series of minima and maxima for the present study, in table 17, illustrates this point. For the reasons cited above, in addition to those presented in the 1953 report, the authors favor the less direct method for determining the means and standard deviations when the basic data are limited in quantity.

TABLE 5

PERCENTILES OF AGE DISTRIBUTION OF EMERGENCE OF PERMANENT TEETH OF FEMALE MONKEYS

Data based on smoothed cumulative frequency ogives and expressed to the nearest hundredth of a year

Teeth		2nd percentile	First quartile (Q_1)	Median (Q_2)	Third quartile (Q_3)	98th percentile	Interval between 2nd and 98th percentiles
Max.	Mand.						
—	M_1	1.15	1.25	1.31	1.38	1.53	0.38
M_1	—	1.24	1.35	1.44	1.53	1.69	0.45
—	I_1	2.13	2.31	2.42	2.56	2.99	0.86
I_1	—	2.16	2.39	2.49	2.62	2.96	0.80
—	I_2	2.21	2.40	2.54	2.71	3.28	1.07
I_2	—	2.34	2.57	2.73	2.91	3.27	0.93
—	M_2	2.68	2.99	3.14	3.30	3.65	0.97
—	C	2.63	2.94	3.13	3.34	4.01	1.38
M_2	—	2.90	3.17	3.33	3.51	3.97	1.07
—	Pm_1	2.82	3.19	3.37	3.58	4.14[a]	1.32
Pm_1	—	2.91	3.21	3.37	3.56	4.15	1.24
C	—	3.02	3.27	3.46	3.70	4.66[b]	1.64
—	Pm_2	2.89	3.26	3.52	3.79	4.40[c]	1.51
Pm_2	—	3.04	3.39	3.65	4.00	4.68[d]	1.64
—	M_3	4.84	5.42	5.74	6.14	7.18[e]	2.34
M_3	—	5.04	5.81	6.23	6.74	9.56	4.52

[a] 4.21 from analysis using logarithmic probability paper.
[b] 4.60; [c] 4.53; [d] 4.93; [e] 7.30, from similar analyses.

Only the first molar data for males were adequate enough to permit statistical analyses by routine techniques. The medians given in table 14 were obtained by noting the ordinate of the point where each cumulative curve crosses the 50 per cent level, while the means and standard deviations were determined from the frequency values supplied by the curves. However, the latter were computed also directly from the original scores, yielding 1.51 ± 0.17 years for the maxillary and 1.39 ± 0.17 years for the mandibular first molar. The 1956 supplementary report should be consulted for other details concerning these two permanent teeth (17).

A study of the contents of tables 1 to 4 reveals the fact that complete symmetry in the development of the right and left halves of dental arches is very rare; in fact, not one of the forty animals with data on all sixteen classes of permanent teeth is perfectly free of chronological asymmetry. Since biologic laterality is always of academic interest, and since, in the case of teeth, information on asymmetries can be of value in estimating the age of a specimen, as was shown in the 1953 report on the deciduous teeth of macaques (16), certain data on this particular aspect of development have been selected for inclusion in table 7.

According to the figures in this table about one-half of all tooth pairs studied show more than a negligible degree of chronological asymmetry. Furthermore, although the limited number of observations on male dentitions necessitates caution before definite conclusions are drawn, it appears that the female macaque is more prone to nonsynchronous emergence of a tooth and its antimere than the male. Even if the comparisons are restricted to the data on first molars and incisors, for which the number of male specimens examined

TABLE 6

EMERGENCE OF PERMANENT TEETH IN FEMALE MONKEYS

Chronological data are expressed to the nearest hundredth of a year

Teeth in most common order of emergence		Number of specimens examined		Computation based on				S.E. of mean* based on number of	
				Original scores		Smoothed ogive			
Max.	Mand.	Tooth pairs	Unpaired teeth	Mean	σ	Mean	σ	Teeth	Tooth pairs
—	M_1	42	0	1.33	0.10	1.32	0.10	0.01	0.02
M_1	—	42	0	1.46	0.11	1.44	0.12	0.01	0.02
—	I_1	41	0	2.49	0.25	2.46	0.21	0.02	0.03
I_1	—	41	0	2.52	0.21	2.51	0.19	0.02	0.03
—	I_2	42	0	2.62	0.31	2.59	0.26	0.03	0.04
I_2	—	41	0	2.77	0.25	2.75	0.24	0.03	0.04
—	M_2	40	0	3.16	0.24	3.15	0.23	0.03	0.04
—	C	39	0	3.19	0.35	3.17	0.33	0.04	0.05
M_2	—	39	0	3.37	0.27	3.36	0.26	0.03	0.04
—	Pm_1	39	0	3.42	0.34	3.40	0.31	0.04	0.05
Pm_1	—	39	0	3.43	0.34	3.41	0.29	0.03	0.05
C	—	38	0	3.59	0.46	3.54	0.39	0.05	0.06
—	Pm_2	36	1	3.57	0.40	3.55	0.38	0.04	0.06
Pm_2	—	35	2	3.73	0.43	3.72	0.43	0.05	0.07
—	M_3	31	0	5.84	0.59	5.81	0.57	0.07	0.10
M_3	—	30	1	6.49	1.04	6.43	0.99	0.13	0.18

* Referring to mean calculated from smoothed ogive.

is the largest, the suggestion of a distinct sex difference remains. Both the frequencies and magnitudes of asymmetries seem lower in the male than in the female, generally speaking.

Without access to any statistical evidence one would anticipate finding more chronological symmetry in the emergence of the teeth of males than of females because of the well-known sex differences in the dimensions of the osseous parts involved. The larger jaws of the male, and the later termination of his physical maturation, would be expected to favor unimpeded functioning of all growth processes that have something to do with the eruption of teeth. Experimentally induced acceleration of maturation in male monkeys furnishes proof in support of this view (39).

The sex difference in the size of the canines in various species of monkeys is often striking (2) (11) (27). In the mulatta macaque this does not result in greater variability and asymmetry in their eruption in the male than in the female. Actually the very large canines of the male show much smaller degrees of chronological asymmetry than either the second premolars or the third molars.

According to table 7 the premolars and canines are the teeth most liable to nonsynchronous emergence. This is not, of course, surprising, since they are more variable than all other teeth except the third molars. However, contrary to expectation, the latter seem to exhibit asymmetry less often than the premolars and canines, but this may be a statistical illusion due to too wide spacing of oral examinations during third molar emergence, especially in the male.

ANALYSES BY INDIRECT OR UNUSUAL METHODS

The limited quantity of data on males made it appear hazardous to proceed on the assumption that conventional biometric techniques could furnish even a crude picture of the parameters pertaining to permanent tooth populations other than the first molars. As shown by the third and fourth columns of table 14 there is a marked reduction in the number of observations as one

proceeds from the first molars to the remaining teeth, this being most pronounced for the canines and third molars.

The matter of interrelationships between the emergence times of the different teeth in individual dentitions had been investigated in considerable detail and reported on in the 1956 supplementary paper (17). By expressing the ages of emergence of the various members of the deciduous dentition and of the permanent first molars in terms of standard, or "Z," scores, it was possible to show that the eruption of one tooth is interlinked with that of another, in spite of a certain amount of variability which may affect the individual units of a set. It was evident that "a given tempo of development did not affect the teeth as isolated units, but rather as integral parts of a larger unit—the dentition—, which maintains its essential characteristics regardless of how rapidly or slowly the process of odontiasis takes place."

Figure 1 is a summarization of the main features of the two scatter diagrams which accompany the 1956 paper. It shows, by two straight regression lines, the rise in the average standard scores, previously arranged in order of increasing magnitude, from − 1.5 (approximate average for males and females) to about + 1.6. Above these lines are two which represent the trends indicated by the most retarded teeth in both arrays of animals, i.e., the teeth with the smallest negative standard scores at the beginning, and the largest positive ones at the end of the series. Here the average rise is from − 0.6 to + 2.9. The lowest pair of regression lines presents the trends of the most precocious units of each dentition, rising from about − 2.2 (average for males and females) to a little over + 0.3 of a standard score.

TABLE 7

CHRONOLOGICAL ASYMMETRY IN EMERGENCE OF PERMANENT TEETH IN THE MONKEY
Chronological data are expressed to the nearest hundredth of a year

Sex	Maxilla					Teeth	Mandible				
	Per cent showing asymmetry	Average asymmetry of		Two highest degrees of asymmetry observed			Per cent showing asymmetry	Average asymmetry of		Two highest degrees of asymmetry observed	
		Total series	Those with trait					Total series	Those with trait		
♂	.37	.02	.05	.10	.10	M_1	.33	.02	.06	.10	.16
	.44	.05	.12	.19	.25	I_1	.20	.03	.14	.12	.29
	.59	.05	.09	.15	.17	I_2	.50	.06	.12	.17	.37
	.28	.04	.13	.11	.25	M_2	.42	.04	.10	.11	.16
	.69	.13	.18	.28	.50	Pm_1	.38	.06	.15	.25	.29
	.69	.16	.23	.42	.58	Pm_2	.65	.11	.17	.33	.42
	.62	.07	.12	.20	.26	C	.54	.06	.11	.14	.36
	.60	.12	.20	.19	.59	M_3	.50	.09	.19	.28	.28
	.54	.08	.14	.21	.34	Average ♂ teeth	.44	.06	.13	.19	.29
♀	.50	.02	.04	.10	.11	M_1	.40	.02	.04	.08	.11
	.56	.06	.10	.24	.37	I_1	.51	.06	.12	.24	.50
	.51	.05	.10	.25	.31	I_2	.57	.08	.13	.33	.66
	.59	.06	.10	.19	.19	M_2	.55	.06	.11	.19	.25
	.67	.11	.16	.42	.73	Pm_1	.56	.10	.18	.35	.45
	.55	.08	.15	.39	.51	C	.64	.11	.17	.38	.50
	.77	.14	.18	.50	.59	Pm_2	.58	.14	.24	.51	.92
	.57	.15	.26	.67	.76	M_3	.48	.10	.21	.50	.78
	.59	.08	.14	.35	.45	Average ♀ teeth	.54	.08	.15	.32	.52

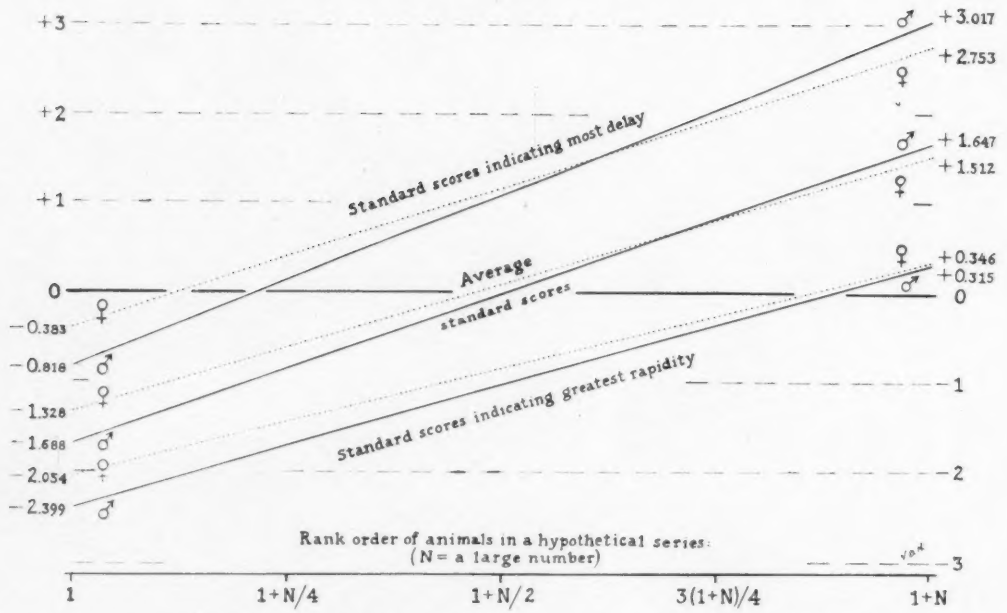

FIG. 1. A summarization of the essential features of emergence data on all deciduous teeth and the permanent first molars in 26 males and 40 females studied in 1956. Note steeper slope of (solid) regression lines for males when contrasted with (dotted) lines for females. For an explanation of other details, see text on pages 113 and below.

Whereas the difference between the extreme deviations is only some 1.6 standard scores at the left end of the series, it is 2.6 standard scores at the right end. The increase in variability is also shown by the gradual divergence of the regression lines as one passes from left to right. This evidence, based on an analysis of 12 pairs of teeth, suggests very strongly that dental maturation occurring early is accompanied by less variability than that taking place later, generally speaking.

Although the numerical values at the ends of the lines in figure 1 may not apply to an infinitely large population of monkeys, there is no reason for doubting that the phenomenon obtains for any sizable group of these animals, hence the designations of rank order in a hypothetical series at the bottom of figure 1.

It follows, from what has been stated, that moderately accurate statistical measures of central tendency and spread of frequency distributions can be either calculated or estimated from population samples of restricted size only if the recorded observations happen to meet certain specific requirements which make it possible to dispense with the ordinarily essential one of randomness, at least in part.

In dealing with small samples, the problem of statistical randomness acquires special significance. There is no assurance, *a priori*, that such samples are not wholly devoid of examples from one or both end portions of a normal range of occurrence of a phenomenon. If the "tails" are represented unequally, there may be no obvious clue as to which of them is missing to a larger degree. The chances of obtaining a population sample with an exaggerated or even entirely false skewness are the greater the fewer the observations. Furthermore, there is also the possibility of securing a sample which gives an erroneous impression of bimodality of distribution, although one must admit that complete absence of, or poor representation from, the midrange of a distribution is seldom encountered unless the number examined is extremely small. The quantity of data on no one class of teeth in the male macaques observed can be described as excessively limited, however.

A study of the details pertaining to the emergence of permanent first molars in the 30 monkeys listed in tables 1 and 2 provides no basis for the belief that these data might be inadequate for computing statistics by orthodox procedures. The impression of sufficiency of quantity and ran-

dominess of the material is conveyed, among other things, by the unmistakably sigmoid shape of the narrow zones formed by plotting the cumulative percentages for these teeth in the 26 to 27 males initially studied (17). Subsequent addition of 3 to 4 new records to the series did nothing to alter the results obtained earlier. The impression of biometric adequacy is strengthened further by noting the intimate association between the measures of variability for the emergence of permanent first molars and all deciduous teeth in the same animals. The data on the latter, which are a representative part of a larger series of 32 to 44 tooth pairs, leave no doubt that both early eruptors and late eruptors are included in the group studied.

Before attempting to determine medians, means, and standard deviations for the remaining fourteen classes of permanent teeth in males, it was considered necessary to gain some idea of the randomness of these tooth population samples. If there were a likelihood that their frequency distributions were unnaturally skewed, or otherwise peculiar, owing to a non-representative character of the samples, application of such straightforward methods of biometric appraisal as had been employed up to this point was either out of the question, or in need of supplementation by other techniques. Disproportionate omission of data on late eruptors, for instance, would result in means that are too low, in sigmas that are too small, and in ranges of distribution that are much too narrow. On the other hand, a relatively even dispersal of losses from the basic male series of 31 individuals would not seriously hamper the applicability of ordinary methods of statistical analysis.

In order to learn something of the representativeness of the shorter series of data, the 31 records on the permanent teeth of male macaques had to be arranged in rank order on the basis of the relative over-all rates of dental development implied by the details of each serial record. However, since the means and sigmas of emergence were unknown for all but two teeth of the male dentition it was impossible to use the "Z" score technique which had proven convenient when dealing with the analysis of deciduous teeth and permanent first molars (16) (17).

In order to circumvent the difficulties arising from the quantitative limitations of male data a special technique had to be adopted. It was tried out first on the permanent tooth records of female monkeys. There was no question about the adequacy of the latter and, in addition, it was possible to check the reliability of the roundabout procedure by using the familiar "Z" score technique on the same female material. It was reasoned that if the procedure had merit it could be applied with some confidence to the records on the teeth of males.

For 37[4] females there were data on all seven classes of permanent teeth, except the third molars, in each jaw, as can be seen in tables 3 and 4. First, the ages of emergence for each class of teeth were placed in rank order, beginning with the earliest age, and keeping the values for right and left teeth separate. Second, numbers indicating the rank order of each age datum were substituted for the latter, the highest number in each series being 37. If two or more animals had emergence of a given tooth at the same age, the rank order figures for these teeth were averaged, and the mid-rank figure was used for each identical age. Third, after determining the rank orders of individual teeth in all 14 morphological categories in the 37 females, the figures obtained for each monkey were added together.

Theoretically, the smallest possible sum total of rank position values for a female was 14, assuming that every permanent tooth (except the third molars) emerged at an earlier age than in any other monkey. In reality, however, the lowest figure obtained was 128.5, which indicated that a number of teeth emerged later than in some other animal. The highest theoretical sum was, of course, 1,036 ($= 28 \times 37$), but the highest total actually obtained was somewhat less, or 963.5, owing to the fact that while one female (dentition no. 13) had very late emergence of all teeth, a few of them appeared somewhat earlier than in other macaques.

Finally, to complete the test, the sums just mentioned were placed in order of increasing magnitude, each animal receiving a number indicating her relative position in the series. A second rank array of females was then established by calculating the average standard scores for emerging permanent teeth in the series and placing them in a similar order of increasing values, which were numbered 1 to 37. A comparison of the two series of numbers showed that 22 females had received the same order number regardless of the method employed, while in 12 instances the rank order designations were but

[4] This excludes dentitions numbered 71 and 72, for which data were secured just prior to publication.

one more or less. In only 3 cases was the difference larger, but not remarkably so.

It was clear, then, that the *relative* rates of odontiasis in a group of animals could be determined even if statistical norms for emerging teeth were not available. Each monkey could be categorized as "faster than," "same as," or "slower than" another monkey, at least roughly.

This technique of comparisons was applied to the data on males. Animals with complete dentition records were placed in order first, then those with less complete records. Many variations of the same basic technique had to be devised owing to the incompleteness of data on several males. The end result is shown in tables 1 and 2, wherein the records for individual dentitions have been arranged in the best order possible. Third molar data were not used in establishing the sequence for either males or females.

A comparison of tables 1 and 2 in this paper and of table 1 in the 1956 report (17) is of much interest in this connection. If "dentition numbers" are substituted for the identification numbers of animals given in the first column of the 1956 table it will be seen that—with the exception of item no. 23[a]—the dentitions listed in the two newer tables are exactly the same, with only five new items added to the original series. (The five additions are listed in the second column of table 8, in parentheses.) Further examination of this material reveals the fact that, broadly speaking, the sequence of numbers in the 1956 and 1959 series is remarkably similar.

Table 8 has been prepared for the purpose of bringing this observation to the attention of the reader, and to present the special features of the parallelism mentioned, not excluding the deviations therefrom. For the sake of completeness the third column of table 8 gives a listing, without any alteration of sequence, of the female dentition numbers that correspond to the "animal numbers" in table 2 of the 1956 paper; the fourth (permanent period) column merely repeats the dentition numbers in the first columns of tables 3 and 4 of the present report. To facilitate study the four arrays of numbers have been divided into thirds which have been "staggered" to increase their differentiation further.

As has been stated already, the listing in tables 1 to 4 is on the basis of decreasing velocities of permanent arch formation. The listing of dentitions in the first two tables of the 1956 publication is on the same basis, even though no reference to this fact can be found in the aforementioned article.

[a] Animal no. 578.

TABLE 8

RANK ARRAYS OF RELATIVE RATES OF ODONTIASIS FOR BOTH PERIODS IN THE SAME GROUPS OF MONKEYS

The numbers are dentition numbers of animals, with a separate system for males and females. For each sex a number appearing in both rank arrays refers to the same animal. Among males numbers in parentheses have no counterpart in adjoining column.

Male dentitions		Female dentitions		Division of rank arrays (arbitrary)
Deciduous period	Permanent period	Deciduous period	Permanent period	
		36	10	First third: earliest; fastest
		8 e	9	
28 e	28	39 e	69	
63	(66)	44	56	
41 e	57	10 e	29	
24 e	24	53 e	8	
62	12	69 e	50	
57 e	51	9 e	53	
38	(40)	68 e	68	
11	(65)	45 e	38	
12 e	41	L. 20	39	
	20	38 e	61	
		56 e	45	
		2	31	
		L. 19	30	Middle third
	33	31 e	17	
51 e	11	17	4	
4	62	4	73	
33	(1)	22	57	
L. 8	56	50 e	2	
56	15	61 e	14	
L. 60	38	62	36	
14	14	L. 23	16	
L. 61	(64)	29 e	22	
15	63	L. 3	44	
	4	L. 5	6	
		73	24	
		6	62	
		L. 21	5	Last third: latest; slowest
		57	21	
L. 19	19	L. 70	3	
20 e	60	30	19	
L. 9	8	L. 15	70	
L. 3	54	L. 13	23	
L. 7	7	14	20	
L. 49	49	24	11	
(23)	9	16	72	
L. 54	61	L. 72	15	
L. 10	3	L. 12	71	
	10	L. 34	12	
		L. 71	34	
		L. 11	13	

Study of table 8 certainly leads to the conclusion that the majority of mulatta macaques tend to maintain, throughout the two periods of odontiasis, the comparative rates of development which characterized them during infancy. This conclusion is in harmony with the findings made earlier by the authors. Individual consistency in rate of dental maturation was strongly suggested by their initial analysis of data on deciduous teeth, and corroborative evidence was presented in the supplementary report of 1956.

Even in the case of the most pronounced deviations shown in table 8 the changes in the basic velocity patterns of odontiasis probably are not as radical as they may seem at first glance. Among males, for instance, dentition number 20[6] is listed just outside the arbitrary limits of the middle third, first on the late side and then on the early side, but the actual shift in rank position involves less than 50 per cent of the total length of the male series. Among females, dentition number 20[6] appears to undergo a more violent change of character, involving 57 per cent of the series, but if the details of this particular emergence pattern are examined it is found to have exhibited erratic oscillations even during infancy. These are mentioned briefly in the 1953 paper (16).

According to the position of the items in tables 1 and 2 the majority of male macaques with very incomplete data on teeth emerging after the age of two years belong among the early eruptors. The first seven dentitions in these tables have no information on the second molars and the teeth emerging after them. Conversely, the best groupings of complete records are to be found in the lower half of each table, and belong to animals which are slow maturers dentally. The practical outcome of all this is the creation of a situation wherein the biometrician can proceed only if he succeeds in basing his calculations upon such data as can be found in the lower two-thirds of these tables.

At first glance the analyst seems to be provided with only one statistically useful characteristic, namely, some degree of definability of the upper end of the range of distribution for each class of teeth other than the third molars. It just happens that, save for dentition number 49, the seven males with the slowest rates of odontiasis have complete records for all permanent teeth except the last molars. Parenthetically, even three full records for the latter are included among these seven cases. Since the slow end of each range of distribution is so well represented, and since the remaining records, taken as a group, deal with the midportions of normal distributions, it does not appear far-fetched to assume that a few of the highest emergence ages to be expected in a random group of 26 male monkeys are to be found in the material at hand.

In addition to the above, there are reasons for believing that the true central tendency of each range of variation can be determined, roughly at least, for all of the permanent teeth of males. According to previous analyses, both of the macaque and man, such statistical measures as the mean, median, and mode are fairly close to each other for most teeth (13) (16), with the probable exception of third molars (36). A certain degree of interrelationship between the emergence times of different teeth in the same dentition has been demonstrated, as well as the existence of fairly wide limits of variability for individual teeth (17). Lastly, the approximate rank order of rates of odontiasis was known for the twenty-six animals which supplied the core of the data on males in this study.

Under these circumstances it appeared entirely feasible to establish, for each anatomical category of teeth, a value which was not far above the true median sought, or which was between it and the *upper* limit of the range of normal variation as depicted by the available data. The difference between the true median and the value mentioned would depend, primarily, on the number of missing items belonging to the group of early eruptors in the material under consideration. In the present case the plus deviations would be the largest for the teeth emerging last in the permanent series.

If arithmetical averages are computed from the data on females in tables 3 and 4 it will be found that they are surprisingly close to the medians shown in table 5. They average only 0.05 of a year higher than the medians if the third molars are left out, and only 0.02 of a year higher than the second set of means given in table 6.

Table 9 supplies the arithmetical averages for the total data on 26 males. It also gives the averages for the teeth belonging to the 13 dentitions with the most rapid rates of development, as well as for the teeth tabulated among the 13 latest and slowest.

The five dentitions (Nos. 66, 40, 65, 1 and 64) which are listed in parentheses in the second column of table 8 have been left out of these

[6] The identicalness of dentition numbers here is purely coincidental and without significance.

TABLE 9

ARITHMETICAL AVERAGES OF EMERGENCE AGES FROM DATA ON PERMANENT TEETH OF TWENTY-SIX MALE MACAQUES

Ages are expressed in decimals of a year; number of teeth observed is shown by small figures below. Sequence of individual items in each group is the same as in tables 1 and 2, or in the second column of table 8, omitting items in parentheses.

Dentition groups (from table 1)	Maxillary teeth							
	M_1	I_1	I_2	M_2	Pm_3	Pm_4	C	M_3
Early-rapid (Nos. 28–38)	1.39 26	2.38 18	2.61 16	3.22 10	3.44 10	3.62 9	4.23 8	5.34 6
Late-slow (Nos. 14–10)	1.63 26	2.62 24	2.97 22	3.49 20	3.83 20	3.95 17	4.33 17	6.06 9
Both groups	1.51 52	2.52 42	2.82 38	3.40 30	3.71 30	3.84 26	4.30 25	5.77 15
Dentition groups (from table 2)	Mandibular teeth							
	M_1	I_1	I_2	M_2	Pm_3	Pm_4	C	M_3
Early-rapid (Nos. 28–38)	1.36 26	2.28 18	2.41 18	3.07 12	3.66 10	3.80 10	3.99 8	5.27 8
Late-slow (Nos. 14–10)	1.48 26	2.57 24	2.71 24	3.29 20	2.89 20	3.96 18	4.06 14	5.82 10
Both groups	1.42 52	2.45 42	2.58 42	3.21 32	3.82 30	3.90 28	4.03 22	5.58 18

calculations purposely. They are later additions to the original series of twenty-six, and appear to belong exclusively in the first and second subdivisions of the rank arrays shown in the table. Their omission from these preliminary analyses did not seem a matter of much importance, yet, had they been included, the averages for the early-rapid group (Nos. 28 to 38) would have been lower and the general averages somewhat less. The latter, as obtained, were felt to be sufficiently high to serve as the upper limits of the ranges of probability in estimating the true median ages of emergence.

Since the preponderance of observations on the teeth of males is supplied by animals with relatively slow rates of odontiasis, it is obvious that arithmetical averages computed from all data presented in tables 1 and 2 will consist of figures which are considerably higher above the true means and medians than is the case with averages obtained for females. This is particularly true of the premolars, canines, and third molars for which there are little or no data from animals with accelerated emergence patterns. For the reasons mentioned one may look upon these averages as representing the upper limits of ranges that contain the true central tendency values sought.

The lower limits of the unestablished medians are not as readily ascertained. The arithmetical averages in table 9, computed from the data included in the first group (Nos. 28 to 38) of thirteen dentitions, undoubtedly give the lowest possible central values for the incisors, which suffer from little loss of data for early-rapid eruptors. For the remaining teeth other methods of estimate appear preferable in order to avoid possible acceptance of too high limits.

A study of the comparatively plentiful statistical material on the dentitions of female macaques confirmed the idea that if the data on a given class of teeth are arranged in order of increasing magnitude, the approximate median is supplied by the item, or items, located half-way between the ends of the total series.

It could also be demonstrated that, if the *relative* over-all rates of odontiasis can be established for a group of dentitions, there are circumstances

under which a complete series of emergence figures is not essential for estimating, with reasonable accuracy, the midvalues for the separate morphological categories of teeth in the group.

The simplest example is one of a rank array from which the first half is missing. In such a case a fair appraisal of the central tendency can be made by merely examining a few of the lowest emergence values in the remaining half. Another illustration is the case of recorded observations for only a few animals known to belong in the midrange of a large, or statistically adequate, random group. In brief, one may say that an estimate of the approximate median of emergence for any class of teeth is feasible as long as some of the available data on individual teeth can be identified as belonging at or near the numerical midpoint of the original series of records, set in order on the basis of relative velocities of dental arch formation.

By taking advantage of the facts just mentioned it was possible to subject the biased samples for the teeth of male macaques to an indirect method of analysis. The procedure followed to find the central emergence time for a maxillary second premolar from the material at hand is described in detail below for the purpose of illustration.

All items for the tooth, presented in table 1, were set in order of increasing magnitude, without differentiation between right and left teeth. There were data on thirty individual teeth out of an ideal maximum of sixty for the animals studied. (Dentition no. 40 was left out of all computations, as it provided information on first incisors only.) Nine of the thirty known values were supplied by dentitions listed in the first half of table 1, while twenty-one came from the second, or late-slow, half of the total series.

Disregarding the sequence given in table 1, which is based on the rank order of entire dentitions, the new array of individual values was divided into two unequal parts. The lowest nine items were considered as representing the very incomplete early-rapid half of the original series, and the upper section of this half in particular. The remaining twenty-one were looked upon as a typical sample of the more complete, but still imperfect, second half of the total group, without a concentration of values at any one level. For an example of the handling of the data just discussed the reader is referred to table 10.

The approximate median age of emergence was estimated by averaging three items just below and three just above the juncture of the early-rapid and late-slow divisions described in the preceding paragraph, and shown on the right-hand side of table 10. The number of items used for this purpose is, of course, quite arbitrary, and must depend upon the discretion of the biometrician. It is self-evident that in most cases the result obtained is relatively independent of the number of figures averaged, provided that the number is small and the line of division does not pass too near either end of the rank array.

TABLE 10

TWO METHODS OF ESTIMATING MEDIANS OF EMERGENCE FROM DATA ON THE MAXILLARY SECOND PREMOLARS OF MALE MACAQUES

Ages expressed in hundredths of a year

Sequence based on rank orders of entire dentitions (table 1)			Averages at and about line dividing data on primary series of 80 dentitions into two equal parts				Sequence based on rank order of individual teeth
Dentition number	Teeth						
	Rt.	Lt.					
	3.37						3.37
		3.37					3.37
	3.61						3.37
		3.70					3.53
	3.59		Early-rapid half				3.54
11		3.59					3.57
	3.82		3.64				3.59
56		3.54				3.59	3.59
15	3.59						3.59
	3.79			3.67	3.62		3.61
38		3.37					3.61
						3.64	
	3.81		3.70				3.70
64		3.81					3.70
	3.61						3.72
	3.94						3.79
		3.98					3.81
	3.72						3.81
		3.88					3.82
		3.53					3.88
	4.37						3.94
		4.29	Late-slow half				3.95
		4.02					3.98
	3.57						4.02
		4.15					4.03
	4.04						4.04
		3.95					4.15
	3.70						4.18
		4.03					4.18
	4.18						4.29
		4.18					4.37

The chief reason for rearranging the data on a class of teeth in order of magnitude is to eliminate any nonrepresentative extreme values from the midsection of the series, where even one grossly deviant figure among the few that are used can mislead the analyst in making his estimate. That such deviants are not too rare is to be expected from a consideration of the wide ranges of variability in the eruption of individual teeth (17). A perusal of the values about dentition numbers 15 and 38 in tables 1 and 2 will serve to illustrate this point. In the case of the mandibular second molar, to cite an example, the lowest value of 2.80 years occurs in the record of dentition no. 56, which is listed just above dentition no. 15. This extreme value is reflected in the midseries average of 3.05 years as shown in line D of table 11, and will be discussed later in this paper (see below and p. 122).

The rank array study of data on the maxillary second premolar yields a median value in the neighborhood of 3.62 years. Similarly computed medians for other permanent teeth, first molars excepted, may be found in line B of table 11.

In order to secure some check on the tentative medians just obtained, two other, completely dissimilar, methods of approach were employed.

The first of these consisted of applying the standard statistical procedure to the material, without attempting any adjustments to compensate for the loss of data from the beginning of each series. It appeared worthwhile to use this method only for the teeth for which the aforementioned shortage was not excessive, i.e., for the two incisors and the second molars of each arch. As would be expected, the means obtained were quite similar to the central values derived by the rank array technique (see table 11, lines A and B). The tendency to higher values, seen in all but two instances, is explainable in terms of the missing low items, this being especially true as regards the second molars. Since the means for tooth emergence are invariably slightly higher than the medians, the tentative figures for the six classes of teeth discussed appear well within the limits of probability.

The second method was founded on the idea that since the listing of data in tables 1 and 2 is not haphazard, but depends upon the over-all velocity of the process of odontiasis, it was reasonable to expect a concentration of the most "typical" emergence values half-way between the ends of the total series. This would be true even though occasional low or high values might be found in the midsections of these tables. Therefore, by averaging a few of the midseries items one would get results indicating central tendencies in a much larger group of males. In applying this method of estimate the biometrician has the advantage of not having to base his calculations upon any specific predetermined number of individual items since, by definition, what is most typical is also most numerous, so that almost any small number out of several is apt to yield comparable results.

Leaving out dentition no. 40, the arrays in tables 1 and 2 were divided into two equal parts, the division occurring between numbers 15 and 38. Four emergence figures—two left and two right—nearest this division and above it were averaged in conjunction with four similarly chosen figures just below the division. The results are recorded in line D of table 11. It can be seen that, generally speaking, or with only one greater and three lesser exceptions, the midseries averages are comparable to the tentative medians estimated by the rank array method (table 11, line B), from which they differ 0.07 of a year, or less.

One of the minor exceptions is the average of 3.05 years for the mandibular second molar, which was referred to above. The other two are the averages for the mandibular incisors. The major discordant figure is that of 3.55 years for the maxillary first premolar, which exceeds the original tentative median by as much as 0.14 of a year.

An explanation of the differences between the two sets of central tendency figures is not difficult; it lies in the strong influence of the few more extreme, or atypical, values that were automatically included in the small midseries groups separated from the total series for the purpose of estimating approximate medians. Although the differences are never large, and average only 0.06 of a year for all fourteen teeth, some of them are admittedly irritating to the analyst. They are evidence of the inability of the indirect methods so far used to distinguish between what is typical of a midrange and what is not. That this is so, is illustrated best by the averages for the mandibular incisors. The upper limits of the ranges of probability are exceeded by these averages, which are also higher than the somewhat excessive means derived by the uncritical application of the standard method. (See table 11, lines D, U, and A.) Yet the use of any technique involving high-handed exclusion of atypical-appearing items from

TABLE 11

MEDIAN AGES AT EMERGENCE ESTIMATED BY VARIOUS METHODS FOR THE PERMANENT TEETH* OF MALE MACAQUES, WITH EXTREME LIMITS OF PROBABLE VALUES

Ages expressed to the nearest hundredth of a year

Line	Methods used to estimate the median and its limits	Maxillary teeth						
		I_1	I_2	M_1	Pm_3	Pm_4	C	M_2
L	Lower limit of range of probability: C–(U–C)	2.46	2.64	3.10	3.39	3.44	3.86	?
A	Mean by standard method, without allowance for missing data	2.49	2.75	3.31	—	—	—	
B	Rank array division ±3 contiguous items[a]	2.51 ±.02	2.74 ±.03	3.25 ±.03	3.41 ±.07	3.62 ±.03	4.13 ±.03	5.31 ±.10
C	Cumulative half-curve, treating "B" as 50% level	2.49	2.73	3.25	3.55	3.64	4.08	5.3 ?
D	Midseries average,[b] Nos. 56, (15, 11 or 1), 38 and 64	2.56	2.76	3.20	3.55	3.67	4.07	5.38
U	Upper limit of range of probability: General average[c]	2.52	2.82	3.40	3.71	3.84	4.30	5.8 ?

Line	Methods used to estimate the median and its limits	Mandibular teeth						
		I_1	I_2	M_1	Pm_3	Pm_4	C	M_2
L	Lower limit of range of probability: C–(U–C)	2.33	2.44	3.09	3.50	3.60	3.75	?
A	Mean by standard method, without allowance for missing data	2.41	2.54	3.19	—	—	—	
B	Rank array division ±3 contiguous items[a]	2.41 ±.03	2.49 ±.02	3.14 ±.03	3.65 ±.03	3.78 ±.03	3.91 ±.04	5.40 ±.05
C	Cumulative half-curve, treating "B" as 50% level	2.39	2.51	3.15	3.66	3.75	3.88	5.3 ?
D	Midseries average,[b] Nos. 56, (15, 11 or 1), 38 and 64	2.51	2.60	3.05	3.68	3.82	3.93	5.37
U	Upper limit of range of probability: General average[c]	2.45	2.58	3.21	3.82	3.90	4.03	5.6 ?

* Statistics on first molars omitted.

[a] Average of 3 items immediately above *and* 3 immediately below line of division, plus or minus difference between foregoing and the average of each 3-item group.

[b] Dentition numbers from tables 1 and 2.

[c] Average for "both groups" from table 9.

a mid-series group would have been contrary to the principles of objective analysis.

A supplementary technique was devised that seemed capable of pinpointing more accurately the location of the true medians than any of the methods employed heretofore, but which, nevertheless, was largely dependent upon the tentative results already obtained. Perhaps it could be called a cross between the rank array method described earlier (pp. 118 and 120) and the smoothed ogive procedure that had proved valuable in previous studies of variation in tooth emergence, utilizing more ample quantities of unprocessed data (16) (17).

Fundamentally this additional means of estimate is an adaptation of the latter method. Instead of constructing a cumulative frequency curve between the levels of zero and 100 per cent,

it is concerned only with the construction of a curve above the 50 per cent level.

If an *approximate* median has been established, it can be treated as the 50 per cent level for the purpose of computing cumulative percentages for all values above it. (The computations are performed by initially treating the assumed median as the zero level. The percentages calculated for values exceeding this median are then halved, and 50 per cent is added to each figure.) By plotting the results and drawing a free-hand line that summarizes the trend revealed by the plotted points one can determine whether the material, considered as an unbroken aggregate, suggests a median identical with the one assumed in the beginning, or one to either left or right of it. By extending the summarizing curve downward until it crosses the 50 per cent line the necessary amount of correction can be determined

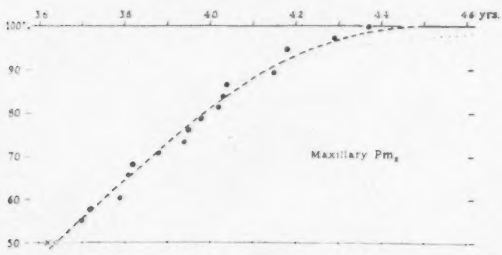

FIG. 2. Cumulative half-curve for the emergence of the maxillary second premolar, assuming *3.62* years (x) to represent an approximate true median. Data above this value, from right-hand column of table 10, are plotted, using circled dots. The downward extension of the heavy broken-line curve crosses the 50 per cent level at 3.64 years, indicated by an empty circle. The curve obtained by a transfer of the modified logarithmic probability line produced at the conclusion of analyses is shown by fine dots. It crosses the 50 per cent level at *3.65* years.

easily. In no case is it likely to be large, if the originally used tentative median has been established with the greatest possible care, and there is no serious shortage of data above the median level.

The construction of the graphs employed is illustrated in figure 2, which presents the cumulative percentage half-curve describing the late-slow values for the maxillary second premolar, shown in table 10. A median of 3.64 years appears more correct than the provisional one of *3.62* years furnished by the rank array method.

The half-curve technique was applied to the data on all fourteen classes of permanent teeth, starting with the tentative figures derived by the division of rank arrays (line B, table 11). The results are surprisingly close to other estimates of central tendency, some a little higher and some lower. None of them conflict with the values accepted as the upper limits of ranges of probability (line U, table 11).

It is of special interest to note that these medians are slightly lower than the means given by the standard method without any allowance for missing low items. They do not support the suspiciously low median of 3.05 years obtained for the mandibular second molar by the midseries average method (line D, table 11), or the equally questionable value of 3.41 years derived for the maxillary first premolar by the rank array division method (line B, table 11).

In the case of third molar data the number of plotted points is too small, and the degrees of variation too large, to permit the visualization of a trend line with any degree of confidence. This is especially true of the upper end of each curve. In the case of the maxillary canine the plotted data very strongly indicate a median of less than 4.13 years.

Supporting evidence of the high degree of correctness of the half-curve medians is furnished by the subsequent studies of the sequence and the time intervals between the emergence of individual teeth. In this connection it is only necessary to remark that the later evidence, discussed on pages 123–124, does not harmonize equally well with the central values estimated by the methods that were employed initially.

The lower limits of the ranges of probability have been added to table 11 (line L) primarily for the sake of completeness of presentation. Their calculation is based on the assumption that the frequency distributions of emerging teeth in male macaques are not markedly skewed in the midranges, except in the case of third molars. Presumably no medians will be found below these limits for any sizable sample of normal, healthy animals.

The meagerness of data on the last few teeth that bring the formation of the permanent series to completion in the male made it commendable to exhaust every possible means for checking the tenability of the medians derived by the modified cumulative percentage method described a little earlier. As shown in table 14 there was information on no more than thirteen pairs of maxillary second premolars and mandibular

canines, and half a pair more of maxillary canines; for the third molars the quantity of material was even less.

The only additional approach that could be devised for dealing with the problem consisted of an analysis of the intervals of time separating the emergence of a given tooth from that of its neighbors. Four such "outwardly quiescent periods" had been described in the 1956 report on permanent first molars (17), but no previous analytical use had been made of data pertaining to this aspect of odontiasis.

Before proceeding with a further examination of the records on male dentitions, the larger body of statistical material on the teeth of female macaques was subjected to a number of exploratory probings. These confirmed the suspicion that the medians established by routine methods of biometric analysis can be duplicated fairly closely by a simple calculation of averages from data on intervals between the ages of emergence of individual teeth. Only one or two previously established medians are needed as a starting point for what additions or subtractions must be performed.

The most striking characteristic revealed was the great variability of these time intervals. Special attention was paid to figures expressing the temporal spacing of teeth which generally are next to each other in order of eruption. It was found that where the periods discussed are relatively short, as, for instance, in the case of maxillary canines and second premolars of females, their variability obscures any differences that may exist between animals with rapid and slow rates of dental maturation. This finding was interlinked with the further discovery that the calculation of the averages mentioned above gave the best results when it was based on all available data rather than on deliberately limited material.

In view of these findings the extension of analyses of dental development in males was based upon all information recorded in tables 1 and 2, without distinguishing between rapidly and slowly maturing animals. Wherever possible, the time intervals studied were computed in two different ways: (1) between teeth on the same side of the sagittal plane, and (2) between teeth on opposite sides of this plane. The dual method provided a check on the correctness of results, since in cases of two intact pairs of teeth the average of "unilateral" figures for the right and left sides would equal the average obtained for the two series of "criss-cross" subtractions. Where a datum was missing for either class of teeth[7] no such check was possible, but two interval determinations could be salvaged, nevertheless.

TABLE 12

TIME INTERVALS BETWEEN THE EMERGENCE OF MAXILLARY SECOND PREMOLARS AND MANDIBULAR FIRST PREMOLARS OF SIXTEEN MALE MACAQUES

Chronological data in decimals of a year

Dentition number	"Unilateral" intervals		"Criss-cross" intervals	
	Right side $Pm_2 - Pm_1$	Left side $Pm_2 - Pm_1$	Right – left $Pm_2 - Pm_1$	Left – right $Pm_2 - Pm_1$
65	.00	.00	.00	.00
20	.15	.06	.15	.06
11	.17	.17	.17	.17
56	.14	.42	.14	.42
15	.00		.10	
38	.08	.50	.08	.50
64	.00	.00	.00	.00
63	.13		.23	
19	−.13	−.42	−.38	−.17
60	.26	.10	.26	.10
54	−.23	−.15	−.23	−.15
7		.12		.15
9	.45	−.42	.16	−.13
61	−.16	−.07	−.16	−.07
3	.52	.04	.37	.19
10	−.17	−.17	−.17	−.17
	.081	.013	.048	.064
Averages	.048		.056	
	.052			

All intervals obtained without—figuratively speaking—crossing the sagittal plane were averaged, and the same was done with the values obtained by the "criss-cross" method. The midvalue between them was taken as the most acceptable expression of the average period of time elapsing between the emergence of the two classes of teeth under consideration.

Table 12 provides an example of the procedure followed in calculating the averages. It also furnishes an excellent illustration of the marked variability of the periods which separate the emergence of one tooth from that of another.

A large number of calculations was made in the manner described, and some of the more important results have been incorporated in figure 3. The topmost of each group of three numbers

[7] There were no instances of two missing data for the same side.

indicates, in hundredths of a year, the inter-emergence period derived from the estimated medians on line C in table 11. The second number, in parentheses, represents the average interval given by the calculations outlined in the preceding paragraphs. The third, which has been underscored, is the value accepted at the conclusion of the analyses as the one in best agreement with the sum total of *all* available information.

It will be observed that the highest number on the side of any triangle in figure 3 is exactly equal to the sum of the numbers on the other two sides, if the parenthetic values are not considered. The latter are in only approximate harmony with each other. This, of course, is to be expected, in view of the general quantitative insufficiency of the material and the unlike number of items available for calculating various averages. Yet, generally speaking, in spite of the statistical handicaps present, the values in parentheses reveal remarkably good concurrence with those obtained indirectly from previous analyses. In only two instances (M_2–M_3 and Pm_2–Pm_3) is the number in parentheses over 50 per cent more or less than the number obtained from cumulative half-curve estimates. In nine cases out of fourteen the agreement between the two sets of figures can be described as either good or perfect.

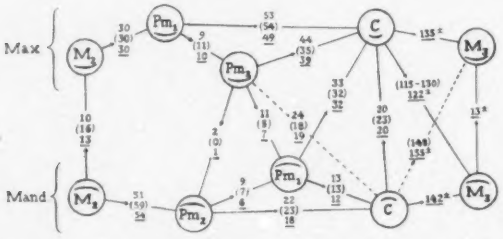

FIG. 3. Condensed presentation of data from interval analyses. Values found most acceptable have been underscored. The figures represent hundredths of a year; an arrow points in the direction of the higher of the two medians compared. For an explanation of other details see text on pages 123 and below.

To reconcile the few more pronounced divergences with each other it appeared advisable to seek compromise values that would place the emergence age of each tooth in the most defensible position when the data are examined from various possible angles. Without indulging in a detailed review of the reasoning followed in dealing with various minutiae, the procedure may be summarized by stating that the most firmly established relationships were altered the least, if at all, and that attention was focused upon the intervals between the canines and the teeth immediately preceding or following them, namely, the premolars and third molars. The commonly observed sequence of eruption was always kept in mind; no revision was accepted that conflicted with something already known with certainty.

Full review and interpretation of the third molar data would require more space than the importance of the subject warrants. For this reason only the values requiring no explanation have been included in figure 3. The intervals found most acceptable are to be regarded as rough approximations.

The results of the final critical survey of median values were used in preparing table 14. The most noteworthy difference between these figures and those on line C in table 11 is the slight—0.04 of a year—downward revision of both canine values (*cp.* p. 128). Of greater moment, however, are the more definite medians for the third molars, which are always of interest in comparative studies of the development of primates (33).

The establishment of reasonably trustworthy medians of emergence for the permanent dentition of male monkeys paved the way for a roundabout determination of such other statistical measures as were needed for a complete description of variation in this growth process.

On the basis of a study of the properties of the cumulative percentage, or "tooth eruption," curve Kihlberg and Koski concluded that it was permissible "to assume one general dispersion law governing the eruption of most of the teeth" (18). They had plotted a number of cumulative percentage curves on normal probability paper against the logarithm of postconceptional age, using data on both deciduous and permanent human dentitions, as well as on the deciduous teeth of the macaque. The result was a series of straight, essentially parallel lines for the dentitions of each primate, without differentiation between males and females.

Employing the same technique, but substituting postnatal for postconceptional age, the present authors graphed the emergence data on the permanent teeth of female monkeys on logarithmic probability paper. (The term, as used in this report, denotes coordinate sheets with a horizontal logarithmic scale, for plotting age, and a vertical scale so designed that cumulative percentages

plotted against it produce straight lines if the frequency distributions are normal and symmetrical, and an *arithmetical* age scale is substituted for the logarithmic one.) The graphs are reproduced in this report as figures 4 and 5.

It will be noted that the lines drawn to indicate the alignment of the plotted points give a first impression of parallelism, especially in the lower half of each figure. They also appear fairly straight, although in the case of the maxillary third molars a distinct curving above the 50 per cent line is evident. In a general way they seem to support the conclusions drawn by Kihlberg and Koski in 1954 (18).

Upon closer inspection it will be seen that few of the lines are actually parallel to each other; there is a tendency for the steepness of the slopes to decrease as one passes from left to right. The divergences are more pronounced above the 50 per cent line than below it. Only three out of the sixteen lines are straight; the rest exhibit more or less curvature toward the right, especially above the 84 per cent level.

The bending of the lines could not be eliminated by adding 0.46 of a year to the emergence ages prior to graphing the material. All that could be accomplished by using postconceptional instead of postnatal age was a cramming of the lines into less space toward the right-hand side of the diagrams, which tended to obscure their true character.

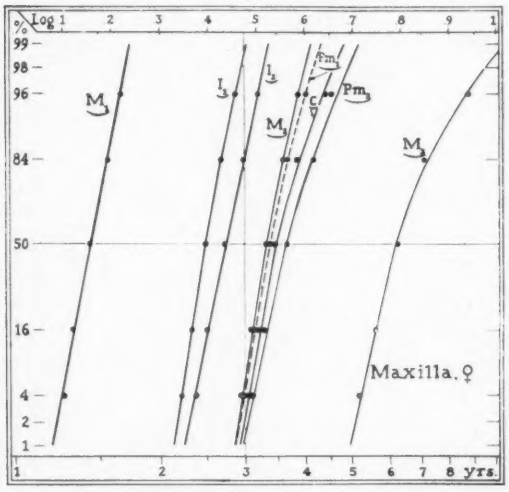

FIG. 4. Cumulative percentages for the emergence of permanent maxillary teeth in normal female macaques plotted on a logarithmic probability grid. Curves suggested by the points have been drawn free-hand where a straight line would have been a poor fit.

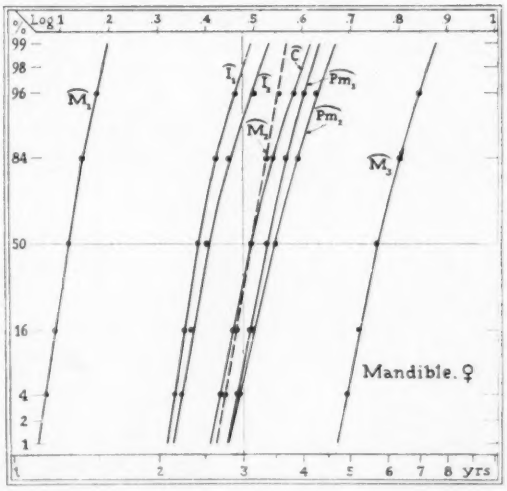

FIG. 5. Cumulative percentages for the emergence of permanent mandibular teeth in normal female macaques plotted on a logarithmic probability grid. The curves have been drawn in the same manner as in figure 4.

According to the findings described above the skewness of the frequency distributions for the monkey is such that the use of a logarithmic probability grid cannot fully straighten out the sigmoid cumulative frequency curves plotted in the usual manner. Yet it is self-evident that if completely straight lines were drawn to indicate the general alignment of the plotted points there would not be any serious, or even moderate, distortion of the actual picture of variation, at least in so far as the first and second molars, and the first and second incisors are concerned. The bending of the lines connecting the points plotted for the percentiles of the third molars is too definite to be ignored, however, especially above the median level.

It may also be said that—with the possible exception of second molar lines—all lines below the median level have nearly identical slopes. There would be negligible distortion of true relationships if they were drawn with perfectly equal slopes up to the 84 per cent level, if not higher. Here, too, the third molars are an exception to the rule; their lines show conformity to the general pattern only in the lower half.

The observations recorded above led to the

very interesting inference that the incomplete data on the permanent teeth of male monkeys were not so deficient in quantity as to preclude all estimates of variability. Since the medians were known with tolerable accuracy, the use of logarithmic probability paper would permit making of estimates of variation provided that the approximate slopes of the straight-line curves for individual teeth could be established.

Fortunately, there were enough observations on the first four pairs of permanent teeth erupting into function in each jaw to make possible the construction of cumulative frequency curves which conceivably did not differ much from the curves that would have resulted from graphing more data. Although six of these eight curves, by themselves, did not allow a determination of precise median values, their transfer to logarithmic probability paper enabled the analyst to draw straight lines which effectively summarized the distribution trends suggested by the total material.

The heavy solid lines in figures 6 and 7 show the results of such transfers. The expected tendency to parallelism is exhibited by these lines; those for the incisors have almost identical slopes in all four instances. As in the case of graphs

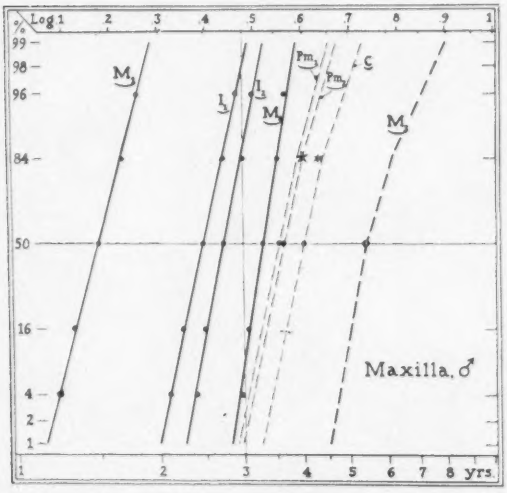

FIG. 6. Cumulative percentage data and estimates for the emergence of permanent maxillary teeth in normal male macaques depicted on a logarithmic probability grid. The solid lines represent a graphing of available data for the first four maxillary teeth; the broken lines indicate estimates made for the other teeth using the technique described on pages 126–128.

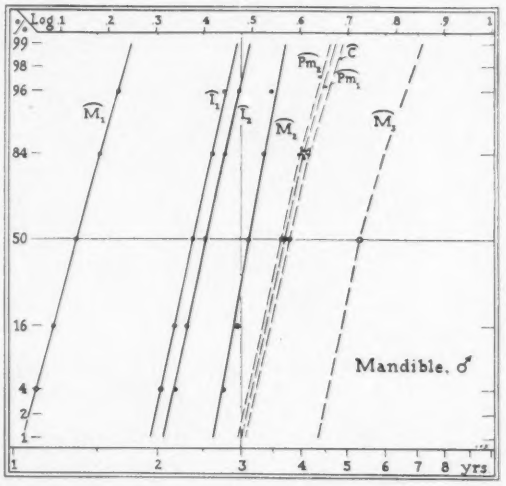

FIG. 7. Cumulative percentage data and estimates for the emergence of permanent mandibular teeth in normal male macaques depicted on a logarithmic probability grid. The lines have been drawn in the same manner as in figure 6.

for the dentition of female monkeys, the second molars seem to be characterized by somewhat less relative variability than the incisors preceding them. In contrast to these graphs, the rather securely established lines for the first molars of males show that they are more variable—on a logarithmic scale!—than the incisors that follow them.

Relying on the frequency distributions suggested by the lines on logarithmic probability paper, and the median values already selected as most acceptable, means and standard deviations were computed for all incisors and both second molars. They are recorded in table 14.

The calculation of statistics for the remaining teeth was more problematic. The maximum number of tooth pairs observed in any one anatomical category was only seventeen, and in all instances the records were inadequate as regards dentitions with relatively early or rapid rates of development. In addition to the above, the frequency distributions for premolars, canines, and third molars were suspected of being distinctly skewed, as were the corresponding distributions for the teeth of female macaques.

An exploratory analysis of the data on females indicated that, just as it was possible to estimate approximate median values of emergence by averaging short series of items from the middle

TABLE 13

DATA USED FOR ESTIMATING PLUS ONE SIGMA VALUES OF EMERGENCE AGES FOR THE PREMOLARS AND CANINES OF MALE MACAQUES, WITH FINAL RESULTS

Chronological data in decimals of a year

Maxillary teeth	M_1	I_1	I_2	M_2	Pm_3	Pm_4	C
Average of six selected dentitions	1.69	2.76	3.02	3.56	4.04[a]	4.01[a]	4.31[b]
Mean + 1σ, according to statistics described on page 126	1.65	2.74	3.00	3.53	—	—	—
84% point of line on logarithmic probability paper	—	—	—	—	3.91	3.99	4.43
Mean + 1σ, according to final statistical estimates	—	—	—	—	3.91	4.04	4.44
Mandibular teeth	M_1	I_1	I_2	M_2	Pm_3	Pm_4	C
Average of six selected dentitions	1.52	2.66	2.83	3.36	4.04[c]	4.04[c]	4.02[c]
Mean + 1σ, according to statistics described on page 126	1.53	2.64	2.76	3.40	—	—	—
84% point of line on logarithmic probability paper	—	—	—	—	3.99	4.07	4.18
Mean + 1σ, according to final statistical estimates	—	—	—	—	4.00	4.08	4.21

[a] Values indicated jointly by larger star in figure 6.
[b] Value indicated by smaller star in figure 6.
[c] Values indicated jointly by star in figure 7.

of a total series arranged in order of relative developmental rates (as was done in calculating the midseries averages shown in line D in table 11), it was possible to estimate plus one sigma ($+1\sigma$) values by utilizing an adaptation of the same technique.

To put this special technique to a test a small number—eight, to be exact—of the complete records from the end portion of the female series (tables 3 and 4) were selected in such manner that the averaged emergence times of the first eight permanent teeth more or less equaled the values obtained by adding one standard deviation to the mean figure of each of the eight teeth. After this, averages were computed for the premolars and canines belonging to the same dentitions. It was found that they differed only 0.09 of a year or less from the $+1\sigma$ values computed from the statistics in table 6. Comparable results could be obtained by slightly varying the number of items and the composition of the series used in the test.

In dealing with the data on the incisors and the first and second molars of males it was found that averaging the emergence ages on six dentitions (Nos. 54, 7, 9, 61, 3 and 10) at the bottom of tables 1 and 2 yielded figures which, with one exception, differed 0.04 of a year, or less, from the previously determined $+1\sigma$ values. This made it seem appropriate to extend the calculations to the premolar and canine material also. The resulting averages are shown on the first line of table 13, and in figures 6 and 7 by stars placed on the 84 per cent line, which corresponds very nearly with the $+1\sigma$ level.

The location of the stars in the logarithmic probability graphs does not introduce a discordant element into the hypothesizing regarding variation in the emergence of premolars and canines. On the contrary, their placement furnishes assurance of the soundness of the conjectures made in the interpretation of data on males. Lines drawn through the points on the median line, parallel to each other and approximately parallel to the incisor lines, pass either through the points marked by the stars, or close to them. Similarly,

were the medians unknown and only the points on the 84 per cent level known, then by assuming near equality of the slopes of the various emergence curves one would find those for the premolars and canines intersecting the 50 per cent line in the immediate vicinity of the median points shown in figures 6 and 7.

The information extracted in the course of the logarithmic probability studies tends to confirm the essential correctness of the previously established medians. It certainly favors the slight lowering of the originally estimated values for the canines, discussed on page 124.

Without doubt the premolars in both dental arches follow each other in quick sequence, tending to emerge *en masse*. The second premolars in the maxilla are virtually synchronous with the second premolars in the mandible, but whereas in the maxilla the first premolars usually precede the former, in the mandible they most often follow the second premolars. Departures from the usual order of emergence are frequent, as has been pointed out by other investigators, including Schultz (32), Zuckerman and Fisher (45), and Baume and Becks (3).

In the lower jaw of the male the developmental schedule of the canines places them in the company of the premolars. In most instances they pierce the mucosa after the latter, especially if the over-all rate of odontiasis in the monkey is rapid, but the slower the rate, the greater seems to be the likelihood of the canines preceding one or more of the mandibular premolars, as can be seen in table 2. In the upper jaw, however, the canine always seems to follow the premolars in emergence, unless the latter are abnormally delayed, as is the right first premolar in dentition no. 7 (see table 1). Yet here, too, as in the mandible, the recorded data suggest that the intervals between premolars and canines gradually shorten as one moves from the more rapidly toward the more slowly completed dental arches.

The data on male teeth were too few to make possible a precise determination of the minor features of the emergence summary curves for premolars, canines and third molars in the upper ends of the ranges of occurrence. Proceeding on the premise that there probably is no significant difference between the character of frequency distributions of erupting teeth in males and females, in preparing figures 6 and 7 the premolar and canine curves were drawn with a slightly lesser slope above the 84 per cent level than below. It was not desired to make the estimates of the probable ranges of variation too conservative.

The third molar curves were drawn approximately parallel to those for the other teeth below the median line, but above this line they were drawn with two definite bends toward the right, or with a restrained imitation of the corresponding curves for females. It was not felt that the meager data at hand warranted the assumption that the third molars of males had frequency distributions displaying as much skewness as those of females. Yet it must be pointed out that the data on dentition no. 61 (table 1) with emergence times of 8.40 years and over for the maxillary third molars, justify the accentuated bending of the hypothetical curve for this tooth in figure 6.

With the completion of figures 6 and 7 it became a simple matter to compute the statistics still missing from table 14. The theoretical limits of the 98 per cent ranges presented in table 15 were obtained by extending the emergence curves,

TABLE 14

EMERGENCE OF PERMANENT TEETH IN MALE MONKEYS

Chronological data in decimals of a year

Teeth in most common order of emergence		Number of specimens examined		Analytical results		
Max.	Mand.	Pairs of teeth	Unpaired teeth	Median	Mean	σ
				Statistics by routine methods		
—	M_1	30	0	1.36	1.37	0.16
M_1	—	30	0	1.49	1.49	0.16
				Statistical approximations by indirect methods		
—	I_1	25	0	2.40	2.42	0.22
I_1	—	25	1	2.49	2.51	0.23
—	I_2	24	0	2.51	2.54	0.22
I_2	—	22	0	2.73	2.76	0.24
—	M_2	19	0	3.12	3.15	0.25
M_2	—	18	0	3.25	3.28	0.25
Pm_1	—	17	0	3.55	3.58	0.33
—	Pm_2	17	0	3.66	3.68	0.32
Pm_2	—	13	4	3.65	3.68	0.36
—	Pm_1	16	0	3.72	3.74	0.34
—	C	13	0	3.84	3.87	0.34
C	—	13	1	4.04	4.06	0.38
—	M_3	12	0	5.3±	5.4±	0.6±
M_3	—	10	0	5.4±	5.6±	0.7±

or lines, in the logarithmic probability graphs down to the first and up to the ninety-ninth per cent levels. These estimates should not be taken too literally, but should be regarded as merely supplying conservative approximations of the true extremes of normal variation. It is to be kept in mind that the latter are not, strictly speaking, definable in precise terms; all one can say is that the true minima are somewhere below the one per cent values, and the true maxima considerably above the ninety-ninth percentiles, owing to the positive skewing of all frequency distributions.

The second and ninety-eight percentiles for the teeth of females were reviewed in a like manner. The figures derived were compared with those based on the study of the smoothed cumulative frequency ogives discussed earlier (p. 110). As a rule the discrepancies were negligible, averaging only 0.02 of a year for all but five items. The more marked deviations are indicated by reference to footnotes under table 5.

For conservative estimates of minima and maxima in the development of female dentitions the values accepted for inclusion in table 15 are those suggested by the curves in figures 4 and 5 when extended to the one and 99 per cent lines. There is reason to believe that some of the observed extremes (within parentheses) in table 15 represent isolated developmental deviants which should not be included in any listing of normal material. Nevertheless, they have not been left out, because of the difficulty of identifying them as abnormal with complete certainty. (Compare the minima and maxima in the two series of figures under "present study" in table 18).

Before leaving the subject of logarithmic probability analyses it is proper to call attention to the fact that probit transformations could have been used equally well (10). The probit technique was not given preference over the one employed, however, as it proved somewhat more cumbersome in actual practice.

Figures 8 and 9 present a graphic summary of the findings pertaining to frequency distributions and ranges of variability in the emergence of permanent teeth of *Macaca mulatta*. They are intended to complement similar figures published in 1953 for the deciduous dentition (16); together the two series of graphs provide a full résumé of the statistical highlights of odontiasis in this species of primates.

The narrow unstippled zone near the left-hand margin of each graph in figures 8 and 9 indicates the horizontal dimension of the space into which

TABLE 15

LIMITS OF NINETY-EIGHT PER CENT RANGES OF VARIATION IN EMERGENCE OF PERMANENT TEETH OF MACAQUES AND OBSERVED EXTREMES THAT FALL OUTSIDE THESE LIMITS

Theoretical limits furnished by first and 99th percentiles of emergence curves plotted on logarithmic probability paper. Observational data, which may include abnormal deviants, are placed within parentheses.

Ages are expressed to the nearest hundredth of a year

Teeth		Males		Females	
Max.	Mand.	Minima	Maxima	Minima	Maxima
M_1	M_1	1.04–1.77 (1.90) 1.13–1.93		1.12–1.87 1.19–1.74	
I_1	I_1	(1.77) 1.93–2.95 1.99–3.08		2.07–3.12 (3.45) (1.98) 2.14–3.01 (3.07)	
I_2	I_2	2.02–3.10 (3.39) 2.25–3.31		2.14–3.41 (3.98) 2.24–3.36	
M_2	M_2	2.63–3.71 2.80–3.84		2.63–3.73 2.85–4.12	
Pm_3	Pm_3	3.10–4.23 2.89–4.50 (4.54)		(2.68) 2.76–4.31 (2.76) 2.85–4.31 (4.80)	
C	C	3.09–4.92 3.27–5.33		(2.51) 2.56–4.16 (4.29) 2.93–4.78 (5.12)	
Pm_4	Pm_4	2.97–4.61 2.96–4.71		(2.59) 2.79–4.70 (2.93) 2.97–5.17	
M_3	M_3	4.3–7.2 4.5–8.0 (8.4)		4.7–7.6 (8.7)* (4.9) 5.0–10.0 (10.9)	

* Dentition no. 70.

the curves for the deciduous teeth would have to be compressed if they were plotted on the same graph as the data on the permanent dentition. The horizontal lines numbered 10, 20, and 30 are for estimating frequencies per 100 monkeys when a tenth of a year is employed as the unit measure of age.[8] Were this scale used for plotting the data on deciduous teeth, all five curves in each separate graph would rise well above the upper margin of the illustrations as now presented. As an example, the summit of the frequency curve for the deciduous maxillary second molar would rise to about 53, although it is one of the lowest in the deciduous group.

The purpose of the comments just made is to point out how the great difference between growth velocities in the earlier and later periods of maturation is reflected in the developmental rates of the highly specialized dental tissues.

STUDIES BY OTHER INVESTIGATORS

As was intimated in the introduction of this paper the number of long-term investigations that

[8] In the study of deciduous teeth a hundredth of a year was used as the most convenient unit of time.

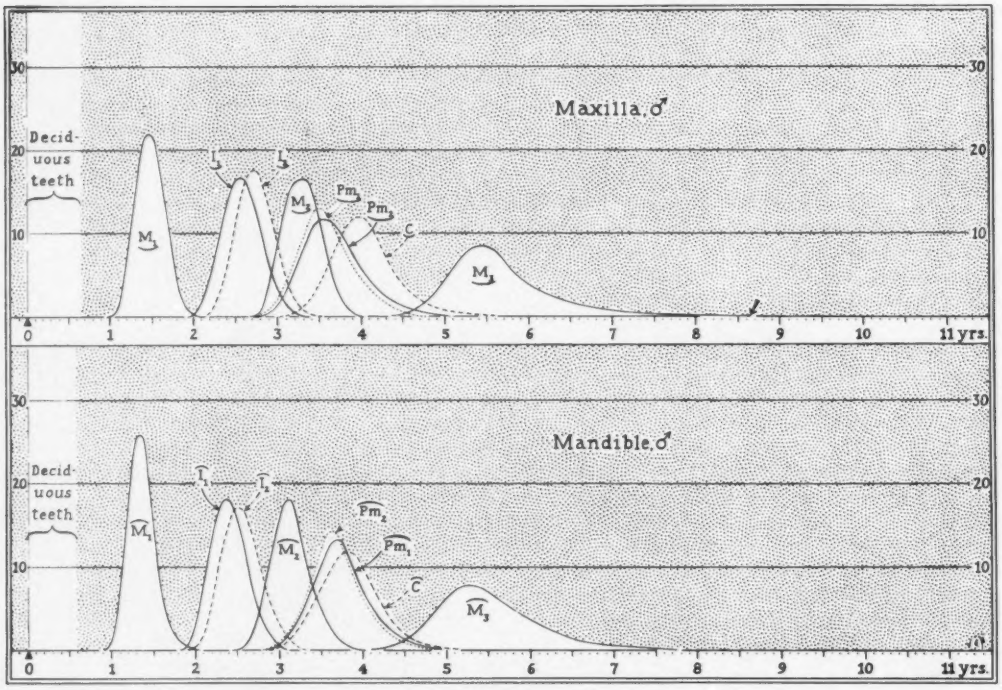

FIG. 8. A graphic representation of frequency distributions in the emergence of permanent teeth of male macaques (*Macaca mulatta*). The end of the maxillary third molar curve is indicated by an arrow. For an explanation of the horizontal lines numbered 10, 20, and 30, and the significance of the unstippled vertical bands marked "Deciduous teeth," see text on page 129.

deal with the complexities of dental development in primates other than man is quite small. The great bulk of odontological literature consists of reports on studies based exclusively on cross-sectional methods, although these are ill-suited for the description and analysis of anatomical transformations occurring in the dentition as normal accompaniments of general physical maturation. The thesis by della Serra on the sequence of eruption of permanent teeth in Platyrrhines can be cited as a good example of this type of study (34).

Variations in the emergence of deciduous teeth of monkeys are much better known than those affecting the permanent series, for reasons already discussed (see pp. 106 and 107). The two recent contributions by Kuksova (19) (20) do not change this situation, since they furnish data on deciduous teeth only. Fortunately, certain previously unpublished observations by Ockerse (26) on the savannah monkey have been made available for inclusion in the present report.

In order to compare the authors' findings with those of other investigators no more than three papers need to be examined in detail. A few references to other writings will be made, however, not omitting a footnote that supplies data on the third molars of the macaque in a paper devoted mainly to the study of the chimpanzee (33).

Table 16 gives some idea of the *relative* numbers of monkeys examined by Spiegel (37), Schultz (32) (33), and Eckstein (7). It is in a form that permits comparisons with the incompletely presented statistics contained in Eckstein's report. The actual quantities of original data collected and studied by the various authors may be more than is indicated by the figures in table 16, which has no provision for including statistics that do not meet the exact specifications of one or more of the four categories defined in the first column. The writers of this paper, for instance, analyzed considerably more data than is

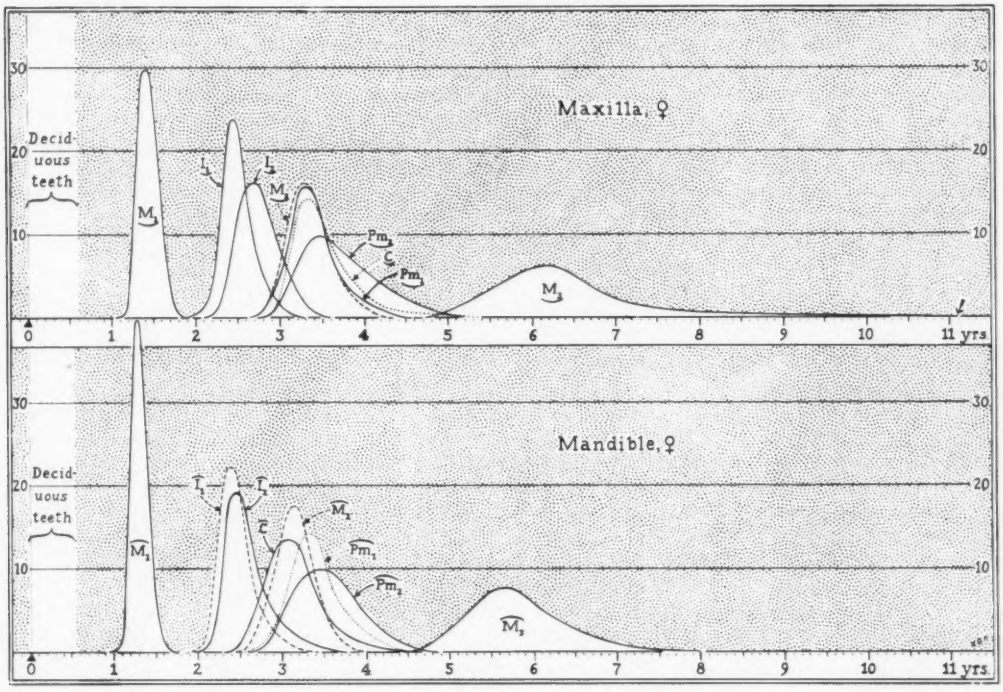

FIG. 9. A graphic representation of frequency distributions in the emergence of permanent teeth of female macaques (*Macaca mulatta*). For an explanation of details, see text under figure 8, and on page 129.

suggested by the figures in the last column of table 16.

Table 17 brings together the most readily compared findings from all sources. Data by Spiegel, Schultz, and Eckstein have been converted into decimals of a year in order to facilitate comparison with the authors' figures. In the case of Eckstein's material it is impossible to differentiate between the sexes in so far as the first six classes of teeth are concerned; beginning with the second molars there are data on the teeth of females only. There is no indication of sex for Schultz's revised values for the third molars (33).

Perhaps the most striking characteristic revealed by table 17 is the natural division of the findings into two main groups, those by Schultz and Spiegel forming one group, and those by Eckstein and the present authors forming the second group. By and large all values in the first group exceed those in the second. The lowest minima are furnished by the present study, while the majority of the highest maxima are reported by Spiegel.

In order to bring the similarities and contrasts into sharper focus, the values shown in table 17 were converted into standard, or "Z," scores, util-

TABLE 16

COMPARATIVE QUANTITIES OF SOURCE MATERIAL UTILIZED IN FOUR SEPARATE STUDIES OF MACAQUES

Permanent teeth present	Sex	Minimal number of specimens studied by			
		Spiegel (1934)	Schultz (1935)	Eckstein (1949)	Hurme and van Wagenen
First molars only (4)	♂	6	4	3	30
	♀	5	5	4	42
First molars and all incisors (12)	♂	4	4	2	22
	♀	2	4	4	41
All teeth except third molars (28)	♂	3	2	—	11
	♀	1	3	3	35
All (32) teeth	♂	3	(1)*		7 (8)†
	♀			3	29 (32)†
Species		*M. irus*	*Macaca mulatta*		

* Information on third molars only. Data based on five additional specimens published in 1940.
† Including late additions.

TABLE 17

AGE RANGES AND AVERAGE AGES AT EMERGENCE FROM DATA OF FOUR SEPARATE STUDIES OF MACAQUES

Averages are simple arithmetical averages, not statistical means. Minima and maxima represent extremes of ranges as observed. Instances of unusual or possibly abnormal deviation from values for a given class of teeth have been left out from second part* of tabulations under "present study."
Chronological data are expressed in years and decimals of a year.

Teeth		Sex	Present study						Schultz (*M. mulatta*)			Stiegel (*M. irus*)			Eckstein (*M. mulatta*)		
			All data			*Excluding possibly abnormal extremes from total data											
Max.	Mand.		Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.
—	M_1	♂	1.04	1.36	1.90	1.04	1.34	1.63	1.50	1.75	2.00	1.50	1.71	1.83	1.33	1.50	1.66
		♀	1.15	1.33	1.56	1.15	1.33	1.56	1.50	1.58	1.66	1.33	1.62	2.00			
M_1	—	♂	1.17	1.49	1.92	1.17	1.49	1.92	1.66	1.85	2.00	1.58	1.72	1.83	1.50	1.66	2.00
		♀	1.27	1.45	1.67	1.27	1.45	1.67	1.58	1.68	1.75	1.42	1.72	2.00			
—	I_1	♂	1.77	2.44	2.93	2.06	2.46	2.93	2.25	2.77	3.00	2.25	2.69	2.92	2.33	2.58	2.83
		♀	2.12	2.48	3.45	2.12	2.47	3.07	2.50	2.78	3.00	2.00	2.54	3.00			
I_1	—	♂	2.11	2.51	3.02	2.11	2.51	3.02	2.25	2.77	3.00	2.66	2.82	3.17	2.42	2.66	2.83
		♀	1.98	2.52	3.07	2.14	2.52	3.00	2.08	2.57	2.92	2.58	2.77	3.25			
—	I_2	♂	2.19	2.57	3.39	2.19	2.56	3.02	2.75	3.12	3.42	2.33	2.94	3.33	2.33	2.66	3.33
		♀	2.18	2.60	3.98	2.18	2.58	3.40	2.83	2.96	3.17	2.66	2.92	3.25			
I_2	—	♂	2.37	2.78	3.21	2.37	2.78	3.21	3.17	3.29	3.42	3.17	3.41	3.66	2.58	2.92	3.33
		♀	2.34	2.76	3.24	2.34	2.76	3.24	3.08	3.17	3.33	2.92	3.38	3.83			
—	M_2	♂	2.80	3.18	3.52	2.80	3.18	3.52	3.17	3.66	4.25	3.42	3.76	4.00	—	—	—
		♀	2.68	3.15	3.71	2.68	3.15	3.71	3.25	3.36	3.50	3.75	4.11	4.75	3.00	3.33	3.66
M_2	—	♂	2.96	3.36	3.70	2.96	3.36	3.70	3.25	3.66	4.00	3.58	3.83	4.17	—	—	—
		♀	2.93	3.36	4.05	2.93	3.36	4.05	3.25	3.42	3.58	—	3.83	—	3.08	3.50	3.75
—	Pm_1	♂	3.37	3.86	4.22	3.37	3.86	4.22	4.08	4.58	5.08	4.25	4.58	4.75	—	—	—
		♀	2.68	3.42	4.25	2.83	3.45	4.25	3.66	3.83	4.08	—	4.25	—	3.33	3.58	3.75
Pm_1	—	♂	3.19	3.71	4.53	3.19	3.68	4.29	4.00	4.38	4.75	3.75	4.30	5.00	—	—	—
		♀	2.76	3.43	4.80	2.92	3.42	4.07	3.50	3.66	4.00	—	4.08	—	3.33	3.50	3.66
—	C	♂	3.60	4.00	4.51	3.60	4.00	4.51	4.58	4.87	5.17	4.66	4.83	5.00	—	—	—
		♀	2.51	3.19	4.29	2.67	3.18	4.07	3.66	3.81	3.92	—	3.50	—	3.00	3.42	3.75
C	—	♂	3.60	4.22	4.61	3.60	4.22	4.61	4.58	5.00	5.42	4.92	5.32	5.58	—	—	—
		♀	2.97	3.58	5.12	2.97	3.52	4.61	3.83	3.92	4.00	—	4.25	—	3.33	3.66	3.92
—	Pm_2	♂	3.26	3.78	4.18	3.26	3.78	4.18	4.00	4.46	4.92	3.75	4.55	5.00	—	—	—
		♀	2.59	3.57	4.68	3.01	3.58	4.68	3.58	3.86	4.08	4.66	4.79	4.92	3.33	3.66	3.92
Pm_2	—	♂	3.37	3.80	4.37	3.37	3.80	4.37	3.83	4.25	4.66	4.17	4.41	5.00	—	—	—
		♀	2.93	3.73	4.80	3.10	3.73	4.80	3.58	3.86	4.08	4.66	4.75	4.83	3.33	3.50	3.92
—	M_3	♂	4.94	5.54	6.93	4.94	5.54	6.93	—	6.33[b]	—	5.83	6.21	6.50	—	—	—
		♀	4.74	5.83	7.62[a]	4.74	5.83	7.62	—	—	—	—	—	—	5.50	6.00	6.50
M_3	—	♂	5.04	5.82	8.40	5.04	5.53	6.45	—	7.50[c]	—	6.17	6.76	7.00	—	—	—
		♀	4.91	6.49	10.87	5.06	6.31	8.53	—	—	—	—	—	—	5.58	6.50	7.58

[a] 8.71—dentition no. 70.
[b] 6.25—average for 1940 data on six macaques, not differentiated according to sex.
[c] 6.83—same as above.

izing the emergence norms developed in this paper. To condense the material further the figures for the minima for each class of teeth in a given dental arch were averaged, keeping the data for the sexes separate (except for six teeth in the case of Eckstein), and also treating each study separately. The standard score equivalents for the averages and the maxima were averaged in a like manner. The resulting statistics are given in table 18.

The averaged standard scores in this table confirm the general impressions conveyed by the detailed data in table 17. The minima reported by Schultz and Spiegel are not even on the minus side of the means, but exceed, with one exception, the averages obtained for the new data presented in this paper. Over one-half of their maxima are above the very high limits of +3.0 standard scores. It is quite evident that if the data by Schultz and Spiegel had been utilized as the basis for deriving standards for evaluating normalcy of distribution, the minima presented by Hurme and van Wagenen would have appeared abnormally low by comparison. The differences reflected in table 18 certainly invite attempts at explanation.

Some definite conclusions are justified if the quantities of data analyzed and the criteria of emergence employed by the different investigators are examined carefully.

In determining the time of emergence of a tooth Eckstein adopted Schultz's (32) criterion—"the time when the entire top of the crown has just pierced the gum." Also, like Schultz, he did not differentiate between teeth on the right and left sides of the sagittal plane. Despite this, and the similarity between the number of specimens studied by him and Schultz, there are consistent divergences between the data given by the two investigators. These differences are brought out by Eckstein in a table accompanying his report (7), but without comment. With few exceptions all values reported by him are below the corresponding values reported by Schultz. The conversion into standard scores (see table 18) only serves to accentuate the distinction between the two series of data.

The matter would remain of no more than passing interest were it not for the fact that in spite of unlike criteria of emergence and a marked inequality in the number of specimens analyzed there is more similarity between the findings of Eckstein and the present authors than between those of Eckstein and Schultz.

The small differences between Eckstein's figures and those furnished by the current investigation are readily explained. The minima found by the writers *should* be lower and the maxima higher than those reported by Eckstein simply because the number of observations underlying the present study is about ten times larger and the data for right and left teeth were recorded separately. The criterion of emergence used in the Yale laboratory also *should* yield averages that are somewhat lower than those obtained from Eckstein's data. One is forced to the conclusion that there is no real conflict between the findings reported in this paper and the observations recorded by Eckstein.

Some comment on the table entitled "The sequence and age of eruption of the permanent teeth," which has been included in at least two publications by Eckstein and Zuckerman (8) (9), seems appropriate in this connection. The average ages of eruption given in the above table for the premolars and canines agree almost precisely with the midsex values computed from the data presented in this paper. Those for the first and second incisors, and for the first and second

TABLE 18

COMPARISON OF DATA FROM FOUR SEPARATE STUDIES BY MEANS OF STANDARD SCORES

All chronological data have been converted into standard scores, utilizing means and standard deviations calculated by Hurme and van Wagenen. The values tabulated represent averages for all teeth in an arch.

Study and species		Arch	Sex	Standard score equivalents for		
				Minima	Averages	Maxima
Present study (*M. mulatta*)	All data	Max.	♂	−1.4	0.3	2.8
			♀	−1.8	0.1	3.2
		Mand.	♂	−1.5	0.2	2.8
			♀	−2.0	0.1	3.6
	Questionable extremes excluded	Max.	♂	−1.4	0.2	1.9
			♀	−1.6	0.0	2.7
		Mand.	♂	−1.3	0.2	1.9
			♀	−1.7	0.0	2.6
Schultz (*M. mulatta*)		Max.	♂	0.7	2.0	3.0
			♀	0.1	0.9	1.7
		Mand.	♂	0.7	2.3	3.8
			♀	0.8	1.5	2.2
Spiegel (*M. irus*)		Max.	♂	1.2	2.1	3.3
			♀	0.8	2.1	4.0
		Mand.	♂	0.6	2.1	3.1
			♀	0.8	2.3	4.5
Eckstein (*M. mulatta*)		Max.	Mostly ♀*	−0.6	0.5	1.7
		Mand.	Mostly ♀*	−0.6	0.7	2.0

*First molar values supplied by both sexes equally; one third of incisor values by males; all other data by females.

molars, are from two to three months higher than the average ages determined by Hurme and van Wagenen. The range of 70–90 months for the third molars is considerably higher than the median range obtained by the present authors, although well within the extremes of 59 and 130 months recorded by the latter.

The statistics supplied by Schultz are to "be regarded as merely tentative figures, based upon relatively few observations of an extremely variable process" (31). His data for the later emerging teeth of males are markedly different from those offered in this paper. About one half of his maxima are even higher than the theoretical ninety-ninth percentiles established by Hurme and van Wagenen. (See tables 15 and 17.)

The most attractive explanation for this disparity is one which postulates considerable difficulty by Schultz in securing sufficiently close spacing of the dental inspections of his adult monkeys, especially in the case of males over three years of age. The high frequency of instances of asymmetrical emergence among premolars and canines (see table 7) probably would have been mentioned by Schultz had the intervals between all his examinations been sufficiently short. It is also likely that in reporting his observations he did not make any allowance for the unavoidable inaccuracies due to the lapses of time between successive examinations, as was done in the present investigation. (*Cp.* p. 110.) And, of course, the use of a different criterion of emergence must have resulted in consistently higher figures throughout. This is particularly true in regard to the canines, which, as stated by Schultz himself, take a long time to come into full function in the dental arches (32).

If the explanation formulated above is sufficiently correct, one is led to the conclusion that the marked parallelism between the data of Schultz and Spiegel should not be interpreted as proof of identical rates of odontiasis in the two species of macaques studied by them. Although the numbers of animals examined were nearly the same, the criteria of emergence adopted by these two observers were different.

Spiegel (37) defined emergence as "der Zeitpunkt des ersten Erscheinens," wherefore one would expect all, or most, values reported by him to be more or less below those reported by Schultz. This, however, is not the case, even though he paid attention to the bilaterality of the eruptive process. The data on canines are especially illuminating, since these teeth have perhaps the slowest rates of emergence, requiring from 9 to 12 months from the initial piercing of the mucosa to completion of eruption, according to Schultz (32). Furthermore, Spiegel states explicitly that the *greatest* error in any of his figures on the permanent teeth is less than one month, whereas there is no precise indication of the maximum error in Schultz's data.

The considerations mentioned above, and a comparison of Spiegel's data—his maxima in particular—with all other material presented in table 17, point toward a slightly later eruption schedule for the crab-eating (Java) macaque (*Macaca irus*) (23) (44) than for the mulatta macaque. Some of the data on the deciduous dentition also point in the same direction, as can be seen by referring to the figures inside blocks in the last column of table 13 in the first paper by the authors (16).

The literature on subhuman primates does not appear to permit any other direct comparisons with the authors' findings. Previously unpublished observations made by Ockerse (26) in South Africa enable one to say, nevertheless, that the considerably smaller (22) (27) savannah, or vervet, monkey (*Cercopithecus aethiops*) is quite precocious when compared with the mulatta macaque.

According to Ockerse the deciduous second molars appear in the oral cavity of this species at the age of 0.20–0.21 of a year, instead of around 0.38–0.45 of a year as in the macaque. Not only is the deciduous dentition begun and finished earlier than in the macaque, but the same may be said about the formation of the permanent dental arches, as can be seen by consulting table 19.

The data on the vervet monkey thus confirm the rule of relative constancy of basic rates of dental

TABLE 19

APPROXIMATE AGES AT EMERGENCE OF PERMANENT TEETH IN THE VERVET MONKEY (*Cercopithecus aethiops*), ACCORDING TO OCKERSE*

Sex differences ignored and number of animals observed not stated. Ages have been converted into decimals of a year.

Teeth	Range	Teeth	Range
Mand. first molars	0.67–1.00	Second molars	1.67–2.00
Max. first molars	0.75–1.00	Second premolars	2.00–2.50
Mand. first incisors	1.00–1.25	First premolars	2.50–3.00
Max. first incisors	1.25–1.50	Canines	3.00–3.33
Second incisors	1.67–2.00	Third molars	3.50–4.00

* The authors are indebted to the Department of Health, Pretoria, Union of South Africa, for permission to publish these previously unavailable data.

development, according to which the over-all velocity patterns of permanent tooth emergence are foreshadowed by those of odontiasis during infancy. If this rule can be applied to other primates it follows that Kuksova's figures for the deciduous dentition of the hamadryas baboon (*Comopithecus hamadryas*) indicate a limited degree of similarity between the schedules of permanent tooth emergence in this species and in the macaque.

Apparently the likeness between the two species is better if only the females are compared, for the data suggest much slower development of male baboons than of male macaques. It may be noted that the average gestation periods are not grossly dissimilar, being about 168–169 days for both the macaque (17) and the hamadryas baboon (42) (43). The two simians are sufficiently alike physiologically to have produced fertile offspring after artificial crossing (20) (30).

The norms calculated for the permanent teeth of *Macaca mulatta* are perhaps of value in estimating the approximate minimal age of specimens of *Comopithecus hamadryas*, since future studies may confirm the observation of Kuksova (20) who also reports that the second species matures more slowly than the first.

TABLE 20

RATIOS BETWEEN AGES AT PERMANENT TOOTH EMERGENCE IN MONKEY AND MAN

(*Macaca mulatta*:*Homo sapiens*::1:x)

Teeth		x	
Max.	Mand.	♂	♀
—	M_1	4.53	4.50
M_1	—	4.30	4.32
—	I_1	2.70	2.54
I_1	—	2.98	2.87
—	I_2	3.03	2.83
I_2	—	3.14	2.98
—	M_2	3.85	3.70
M_2	—	3.87	3.65
—	Pm_1	2.89	3.00
Pm_1	—	2.91	2.94
—	C	2.79	3.11
C	—	2.88	3.10
—	Pm_2	3.12	3.07
Pm_2	—	3.04	2.93
—	M_3	3.53	3.80
M_3	—	3.66	3.18
Average		3.33	3.28

COMPARISONS WITH THE DENTITION OF MAN

The mulatta macaque is the first subhuman primate, and the first diphyodont mammal, for which dental development is known in sufficient detail to permit fairly extensive comparisons with the age changes that characterize the human dentition between infancy and the attainment of adult status. The information now available enables one to examine several areas of interest which were quite inaccessible in the past. Only a few of them will be identified before this paper is brought to a conclusion.

According to table 20 the schedule of permanent tooth emergence in the monkey is from 2½ to 4½ times as fast as that in man. It will be noted that the first molars, as a group, are the most accelerated teeth in a relative sense, their mean ages of emergence requiring multiplication by 4.3 to 4.5 in order to equal the means for corresponding human teeth. The ratios for the other molars are also much higher than the ratios for the remaining units of the permanent dental arches.

In further contradistinction to man, the appearance of the permanent first molars is followed by a relatively long outwardly quiescent period. An interval of about a year separates the emergence of these teeth from that of the first incisors, which are next in sequence. (See tables 6 and 14.)

Unlike in man, there is no extended pause after the emergence of the permanent second incisors, which in the monkey are soon followed by the permanent second molars, long before any of the deciduous molars and canines have been exfoliated. In the human species, after an interval of more than a year and a half, the first premolars and canines, and usually the second premolars also, take their places before the permanent second molars come into function (4) (14) (15). This sequence of events should never be expected in the monkey.

In both primates there is a sex difference in the order of eruption, involving the same classes of teeth in each. The most pronounced difference is exhibited by the canines, which appear much later in the male than in the female. As in the human species, the mandibular first premolar also erupts relatively later in the male.

The observation that the general rate of development may have some influence upon the

pattern of emergence of canines and premolars in the monkey (*cf.* p. 128) cannot be readily substantiated by a review of literature. In view of the paucity of suitable data it is of interest to note that Nagamine (24) has evidence suggesting similar interrelationships in the development of the human permanent dentition.

Chapter 8 (§7) of his lengthy paper contains the following remarks, translated from the original:

> As for a comparison between the second premolars and the canines of the upper jaw, during the early part of the emergence period* the emergence index of the second premolars is far greater than that of the canines. However, toward the end of the emergence period such relations become quite reversed and . . . the speed of the canines becomes slightly faster.

The second premolars of the macaque seem particularly prone to developmental aberrations, being comparable to those of man in this respect. One instance of agenesis is recorded in table 1 (dentition no. 7) and another in table 3 (dentition no. 30). In addition to the above, table 4 gives an example of what may prove to be a complete failure to erupt (dentition no. 71). Agenesis of a maxillary right first premolar was seen in a female (dentition no. 74) not belonging to the series analyzed in this paper. Similar anomalies were not found in any other class of permanent teeth, if one disregards the few instances of markedly delayed emergence of the third molars.

The very asymmetrical frequency distribution curves obtained for the third molars of the monkey are highly reminiscent of the clinically observed behavior of wisdom teeth in the human species. This resemblance is emphasized further by the statistically revealed contrast between the maxillary and mandibular third molars, the former being more unpredictable than the latter. Comparable differences have been noted in the development of these teeth in man (25).

By contrasting the statistical measures of variability for individual classes of permanent teeth in the two species of primates one is led to the conclusion that while there is a great deal of similarity between them, the human organism is somewhat more unstable than that of the mulatta macaque. Referring to table 21 the standard deviations for the teeth of man are on an average about 4½ times as large as those for the teeth of macaques, although, as shown in table 20, the ratios between the emergence ages cluster around the appreciably smaller figure of 3⅓. This difference can be interpreted as indicating less heterogeneity in a monkey population than is likely to be found in a human population sample.

* The term, as used by Nagamine, refers to the statistical age range during which emergence is likely to take place.

TABLE 21

RATIOS BETWEEN MEASURES OF VARIABILITY OF PERMANENT TOOTH EMERGENCE IN MONKEY AND MAN

Standard deviations for maxillary and mandibular teeth of the same general denomination have been averaged. Midsex values have been used in all computations.

(*Macaca mulatta*:*Homo sapiens*::1:x)

Teeth	Approximate sigmas (years)		x
	Macaque	Man	
M_1	.14	.80	5.7
I_1	.21	.80	3.8
I_2	.24	.93	3.9
M_2	.25	1.37	5.5
Pm_1	.32	1.47	4.6
Pm_2	.36	1.63	4.5
C	.36	1.32	3.7
		Average	4.5

The life span of *Macaca mulatta* is generally believed to be somewhere between fifteen (1) and thirty years (8) (40), but in the absence of vital statistics on simians more precise estimates have remained quite provisional. As yet it is not known how old a macaque must be to be physiologically comparable to a man of "three score and ten," who may, under very favorable circumstances, add as much as 40 per cent more to the number of his years.

It is highly probable that there is a fairly fixed mathematical relationship between the characteristic rate of dental maturation and the potential life span of the hypothetical average individual of a species. If this is true, and the monkey is conceded to be biologically similar to man, it is possible to estimate its life expectancy provided that the approximate ratio between the velocities of dental development in the two primates is known.

According to table 20 the ratio sought is in the neighborhood of 3.3 to 1. However, there is some question of the advisability of including the molar data in the computation of the interspecies ratio, since in the monkey the molars are formed at a rate that places them into function very early in

TABLE 22

AGES AT PERMANENT TOOTH EMERGENCE EXPRESSED AS FRACTIONS OF TOTAL LIFE EXPECTANCY IN MONKEY (23 YEARS) AND MAN (70 YEARS)

Teeth		*Macaca mulatta*		*Homo sapiens*	
Max.	Mand.	♂	♀	♂	♀
—	M_1	1/16.8	1/17.4	1/11.3	1/11.8
M_1	—	1/15.4	1/16.0	1/10.9	1/11.3
—	I_1	1/9.5	1/9.4	1/10.7	1/11.2
I_1	—	1/9.2	1/9.2	1/9.4	1/9.7
—	I_2	1/9.1	1/8.9	1/9.1	1/9.5
I_2	—	1/8.3	1/8.4	1/8.1	1/8.5
—	M_2	1/7.3	1/7.3	1/5.8	1/6.0
M_2	—	1/7.0	1/6.8	1/5.5	1/5.7
—	Pm_1	1/6.2	1/6.8	1/6.5	1/6.9
Pm_1	—	1/6.4	1/6.8	1/6.7	1/7.0
—	C	1/5.9	1/7.3	1/6.5	1/7.1
C	—	1/5.7	1/6.5	1/6.0	1/6.4
—	Pm_2	1/6.3	1/6.5	1/6.1	1/6.4
Pm_2	—	1/6.3	1/6.2	1/6.3	1/6.4
—	M_3	1/4.3	1/4.0	1/3.4	1/3.4
M_3	—	1/4.1	1/3.6	1/3.4	1/3.4

relation to the rest of the permanent dentition. Probably the best teeth for comparative purposes are the sex-linked canines, and the premolars which are closely associated with their development and eruption. The ratio based on the emergence times of these teeth suggests that the monkey matures about three times faster than the human organism. Presumably this primate also reaches senescence with equal speed.

If seventy years is accepted as a convenient round figure for expressing the life expectancy of man (21), the 3 to 1 ratio discussed places the life span of an average monkey (which is not killed by accident or design) at about twenty-three years. Calculating the ages of permanent tooth emergence in terms of these survival figures yields the fractions shown in table 22.

As would be expected, the fractions for the corresponding teeth of macaques and man are very similar, the molars excepted. Only by using the very improbable value of sixteen years as the basis of calculations for the monkey can the fractions for the first molars be made equal to those for man, but then the interspecies parallelism for the other permanent teeth disappears.

The presentation just made does not, of course, prove the correctness of the life expectancy figure obtained for the monkey; only direct observations might do that. Nevertheless, it is offered as an example of the possible wider uses of dental data in solving biological problems.

SUMMARY

The age changes that characterize the development of the permanent dentition in subhuman primates are still largely undescribed. Relatively little new information has become available since Schultz (31) and Spiegel (37) published their pioneering researches on the teeth of macaques in 1933 and 1934. There are many difficulties in securing longitudinal data on a statistically adequate number of full-grown animals of known age, and very few primate laboratories in the world today possess sufficient resources for even attempting such growth studies as would be necessary.

The biometric analyses set forth in the present report are based on the records of monthly observation of 31 male and 42 female specimens of *Macaca mulatta*, born and reared in captivity in the monkey colony at Yale University since 1935. Only normal and healthy animals have been included in the analyses. The personal variable in the study is a minimal one, since all dental examinations were performed by one and the same individual.

The data on females, and some of the data on males, were analyzed by employing conventional statistical methods, or minor modifications thereof. The records on males, however, were found to be quantitatively deficient in observations on dentitions that develop early and rapidly. By recourse to several combinations of indirect methods of analysis, which were tested on the more adequate data available on the teeth of female macaques—for which statistics had already been computed in the customary manner—it was found possible to derive emergence norms for males also.

The indirect methods mentioned were largely the result of putting into use the knowledge of dental interrelationships that was gained from the authors' earlier studies of odontiasis in the macaque. An awareness of both the uniqueness and *relative* constancy of basic rates of dental maturation in individual monkeys resulted in the adoption of a philosophy which led to many restraints in the application of conventional statistical techniques for the assay of data that are of marginal adequacy quantitatively. Fortunately, the same philosophy of appraisal also suggested

a methodology for extracting valuable information from incomplete serial records, provided that certain specific requirements can be satisfied.

The marked variability in velocities of odontiasis is brought out clearly by the investigation. A macaque at one extreme of the velocity scale may be more than twice as fast as one at the other extreme in completing the formation of its dental arches. As a general rule, the tendency to variation increases with age. Chronological asymmetries appear as a by-product of this natural inclination, and are more frequent and of greater degree in the emergence of premolars, canines, and third molars than in the case of earlier erupting pairs of teeth. The maxillary teeth seem to be involved somewhat more often than the mandibular ones.

The emergence pattern of premolars and canines is not the same for the two sexes, the canines in particular appearing considerably later in the male. The permanent first molars also reveal a sex difference in the monkey, those of the male being much more variable than those of the female. Completion of dental arch formation, as marked by the advent of the third molars, is generally tardier in the female than in the male.

The establishment of standards of variation for the emergence of all teeth of *Macaca mulatta* opens the way for attempting a critical evaluation and recapitulation of studies by other authors who have dealt with the dentition of this primate.

In the light of the new data, and a comparison with Eckstein's findings, the tentative figures released by Schultz in 1933 (*31*), 1935 (*32*), and 1940 (*33*) appear too high generally, while the sequence of eruption described by him seems essentially correct. The emergence schedule prepared by Eckstein and published in 1949 (*7*) is in fair agreement with the mean values presented in this paper, although a few of his figures also must be regarded as somewhat too high.

The data by Spiegel (*37*) on *Macaca irus* suggest that this closely related species is a little slower in its dental maturation than *Macaca mulatta*. Surprisingly enough indirect evidence, contained chiefly in a recent report by Kuksova (*20*), points toward some similarity between tooth formation in the latter species and in *Comopithecus hamadryas*, which has a facial configuration quite unlike that of the "rhesus" macaque. The writers offer the norms computed for *Macaca mulatta* as a tentative guide for estimating the minimal age of specimens of the hamadryas baboon.

Sketchy data by Ockerse (*26*) on *Cercopithecus aethiops* prove beyond any doubt that this smaller species is not comparable to *Macaca mulatta*, but is faster at all stages of its dental development.

Most of the dissimilarities between the schedules of permanent tooth eruption in the macaque and in man can be related to the comparatively early emergence of all six pairs of molars in the former. Although the first molars are usually the first members of the permanent dentition to come into function in man, they are preceded by the mandibular first incisors in a fairly large percentage of individuals (*5*). This never happens in the monkey; the early arrival of the first molars is always followed by a long pause before the mandibular first incisors can be seen in the mouth. The interval of time separating the emergence of the second molars from that of the second incisors is quite short in the macaque, whereas it is so long in the human species as to allow the premolars and canines to be added to the dental arches before the second molars are ready for their debut.

The rate of odontiasis in the mulatta macaque is roughly triple that in man; yet variability in this simian is confined within limits that are much less than a third of those calculated for the human organism.

Among the outstanding interspecies parallels one can list the existence of similar sex differences in the order of eruption of individual teeth, similar tendencies to variability and chronological asymmetry when one morphologic class of teeth is compared with another, and the greater unpredictability of the maxillary than of the mandibular third molars.

The dental data afford a hypothetical basis for equating life expectancy for the monkey with that for man. According to the calculations made by the authors twenty-three years for *Macaca mulatta* is the approximate equivalent of seventy years for *Homo sapiens*.

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